Basic IMPRINT Workshop

IMPRINT Team

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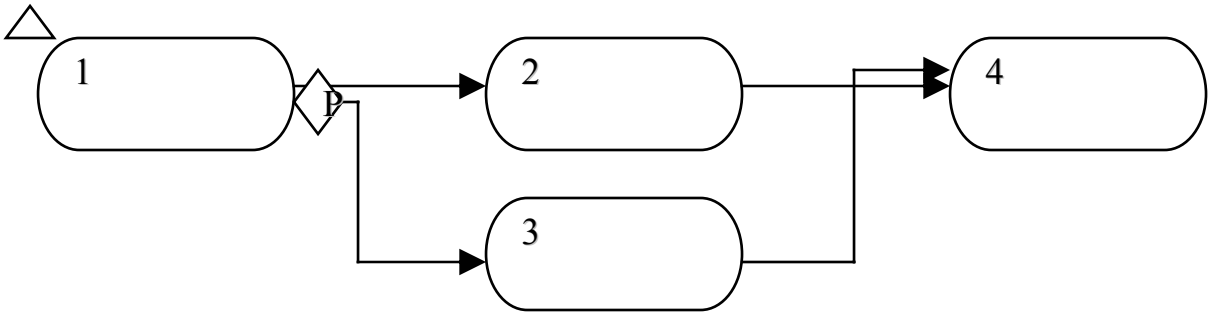
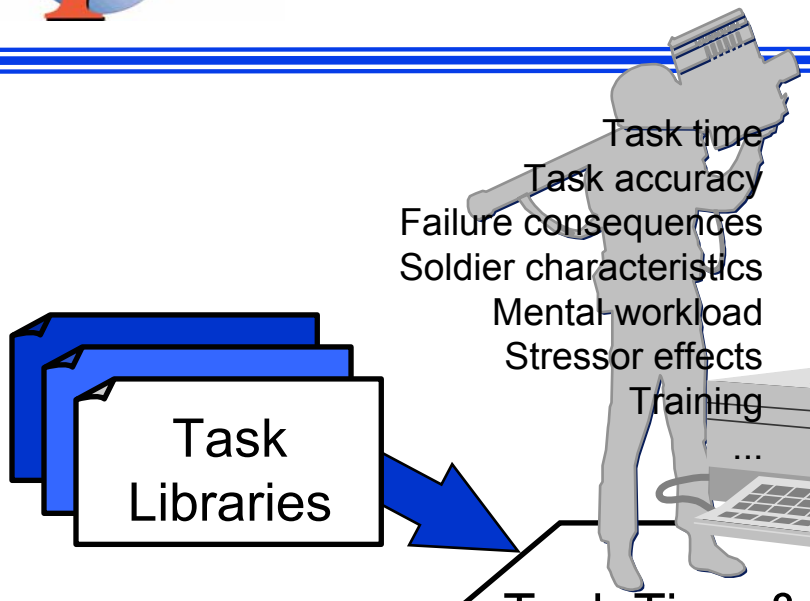
Introduction

What is IMPRINT?

- It is a ***tool***
- Army-developed soldier-system analysis ***tool***
- Improved Performance Research Integration ***Tool***



IMPRINT Architecture



Unit & Force

Task Libraries

System Measures

Task Time & Error Data - Estimates & Requirements

Soldier Data
Workload
Future Manpower
Stressors...

Model

What Does IMPRINT Do?

It helps you...

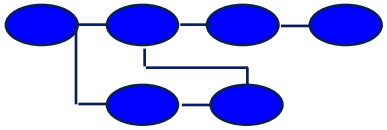
- Set realistic system requirements
- Identify future manpower & personnel constraints
- Evaluate operator & crew workload
- Test alternate system-crew function allocations
- Assess required maintenance manhours
- Assess performance under extreme conditions
- Examine performance as a function of personnel characteristics, training frequency & recency
- etc.

How Does IMPRINT Do It?

- Stochastic task network modeling
  - Build your own mission model

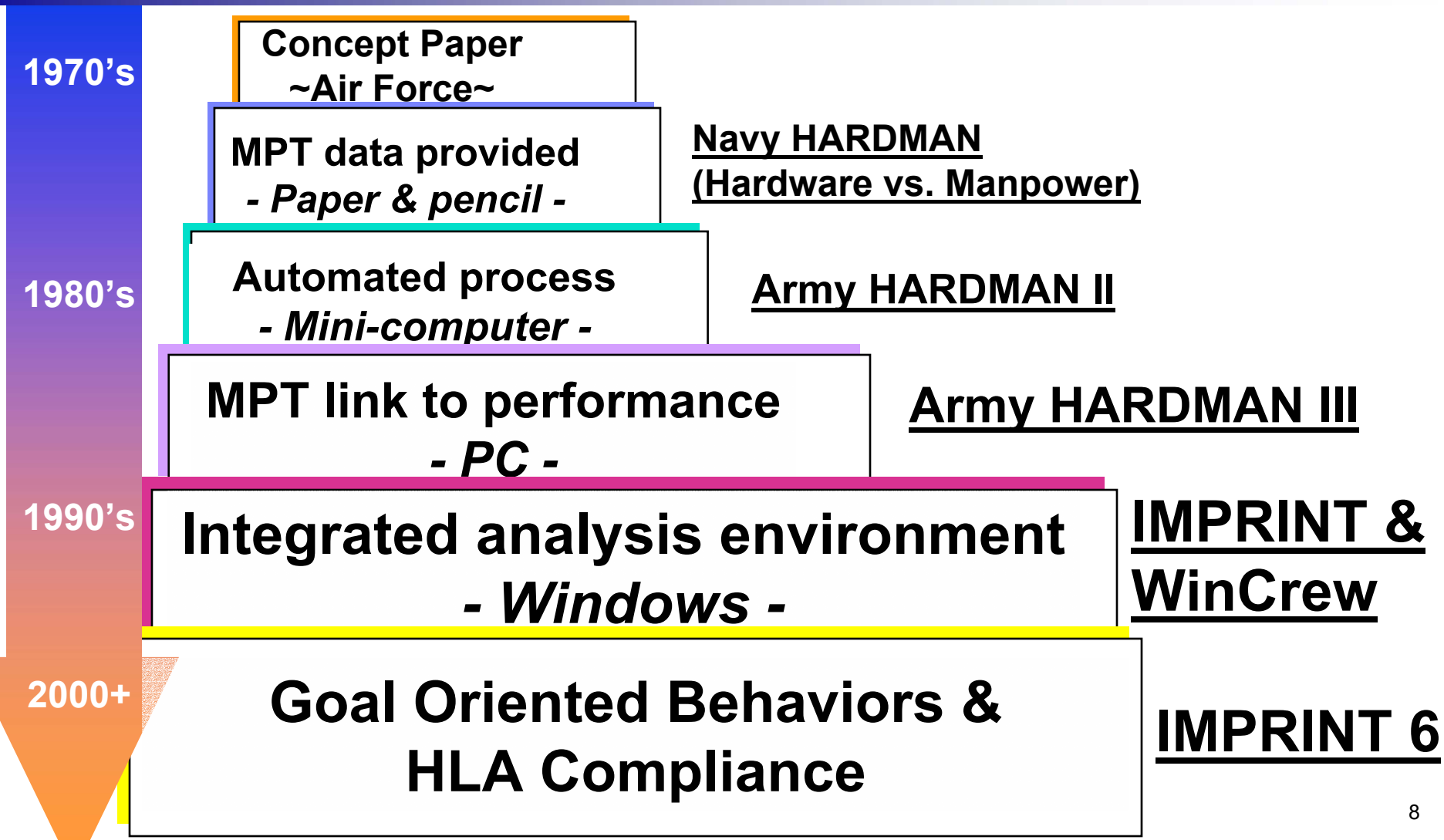
    time, accuracy, task type, failure…
  - Parameterize maintenance model

    MTTR, MOUBF, combat damage, rounds fired…



- Workload modeling: VACP & Advanced
- Performance shaping functions & stressors
- Manpower projection
- Access data libraries: System & soldier data
- Force-level roll-up

IMPRINT: Evolution & Revolution



IMPRINT Verification, Validation & Accreditation

- Per AR 5-11, Army Model and Simulation Management Program
- Accreditation Board
  - ADCSPER, Chair & Members representing policy, users, testers, materiel developers, decision makers
- Effort completed 2QF 95 -
  - Define Mission, VACP, PTS
- IMPRINT is a tool for building models & includes embedded models!
- VV&A may be required for user-developed models

Extra Benefits of Doing V&V

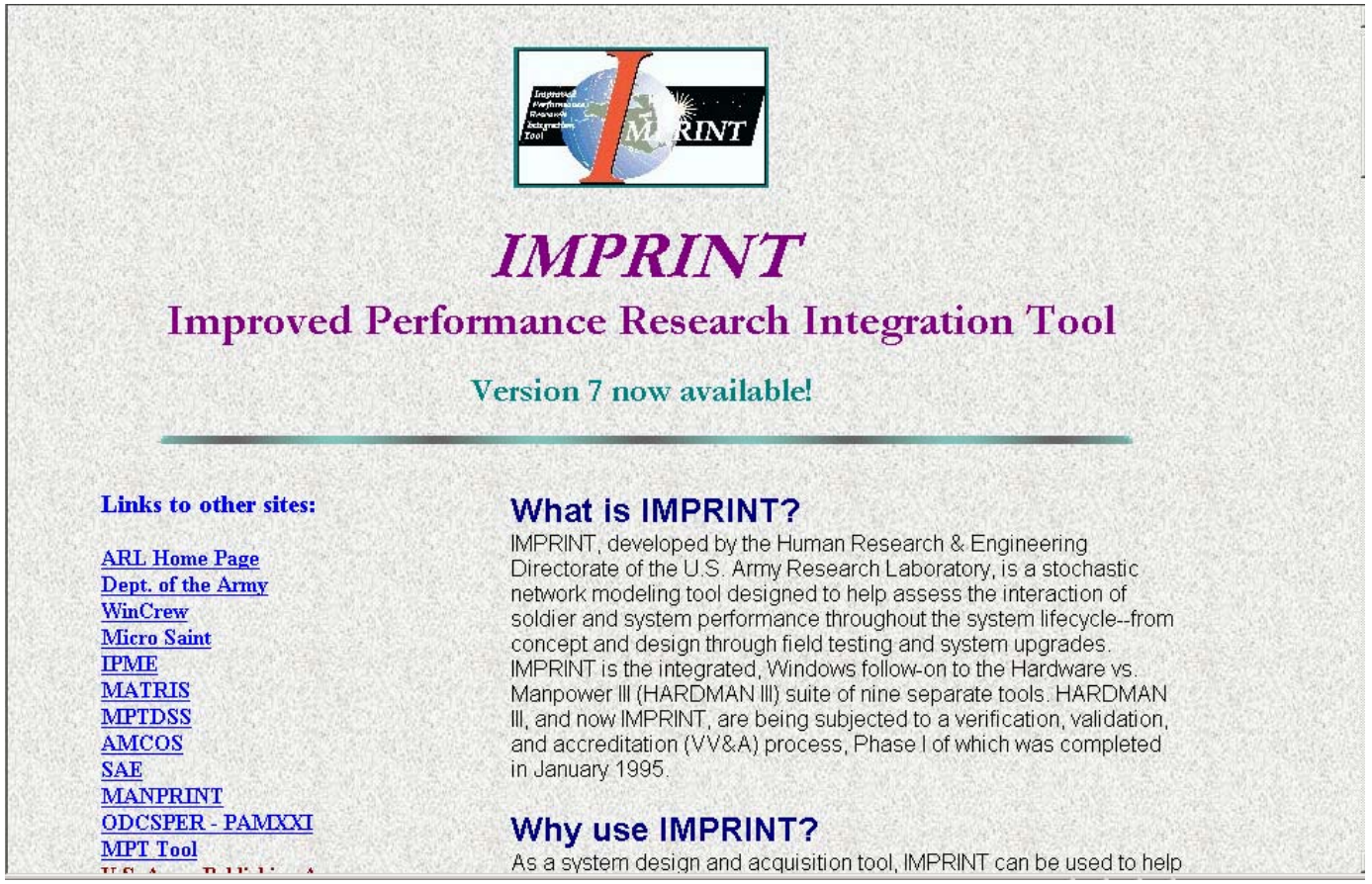
- It's a great way to debug software
- It drives you to document model assumptions and limits
- It goes hand in hand with configuration management
- It helps build toward model standards, data sharing, etc.
- It's a way to reduce system risk
- If you do it right in the beginning, the "savings" are realized throughout the life-cycle
- It helps you develop rapport with the customer
- It helps build credibility for human performance modeling across the board!

Who Has IMPRINT?

Army	97
Navy	20
Air Force	6
Other Government	8
Contractors	91
University	15

- 237 and growing!

IMPRINT Web Page



IMPRINT

Improved Performance Research Integration Tool

Version 7 now available!

Links to other sites:

ARL Home Page
Dept. of the Army
WinCrew
Micro Saint
IPME
MATRIS
MPTDSS
AMCOS
SAE
MANPRINT
ODCSPER - PAMXXI
MPT Tool

What is IMPRINT?

IMPRINT, developed by the Human Research & Engineering Directorate of the U.S. Army Research Laboratory, is a stochastic network modeling tool designed to help assess the interaction of soldier and system performance throughout the system lifecycle--from concept and design through field testing and system upgrades. IMPRINT is the integrated, Windows follow-on to the Hardware vs. Manpower III (HARDMAN III) suite of nine separate tools. HARDMAN III, and now IMPRINT, are being subjected to a verification, validation, and accreditation (VV&A) process, Phase I of which was completed in January 1995.

Why use IMPRINT?

As a system design and acquisition tool, IMPRINT can be used to help

http://www.arl.army.mil/ARL-Directorates/HRED/imb/imprint/imprint.htm

Development of Analysis

OR

D . O . A

What is a Model?

Mr. Webster says:

1. A small object, usually built to scale, that represents another, often larger object. 2. A preliminary pattern serving as the plan from with an item not yet constructed will be produced. 3. A tentative description of a theory or system that accounts for all of its known properties.

Law and Kelton say:

Mathematical and logical relationships that describe system behavior.

Mr. R. Estell says:

An abstraction of reality.

Why Modeling?

Many Variables

Concept System

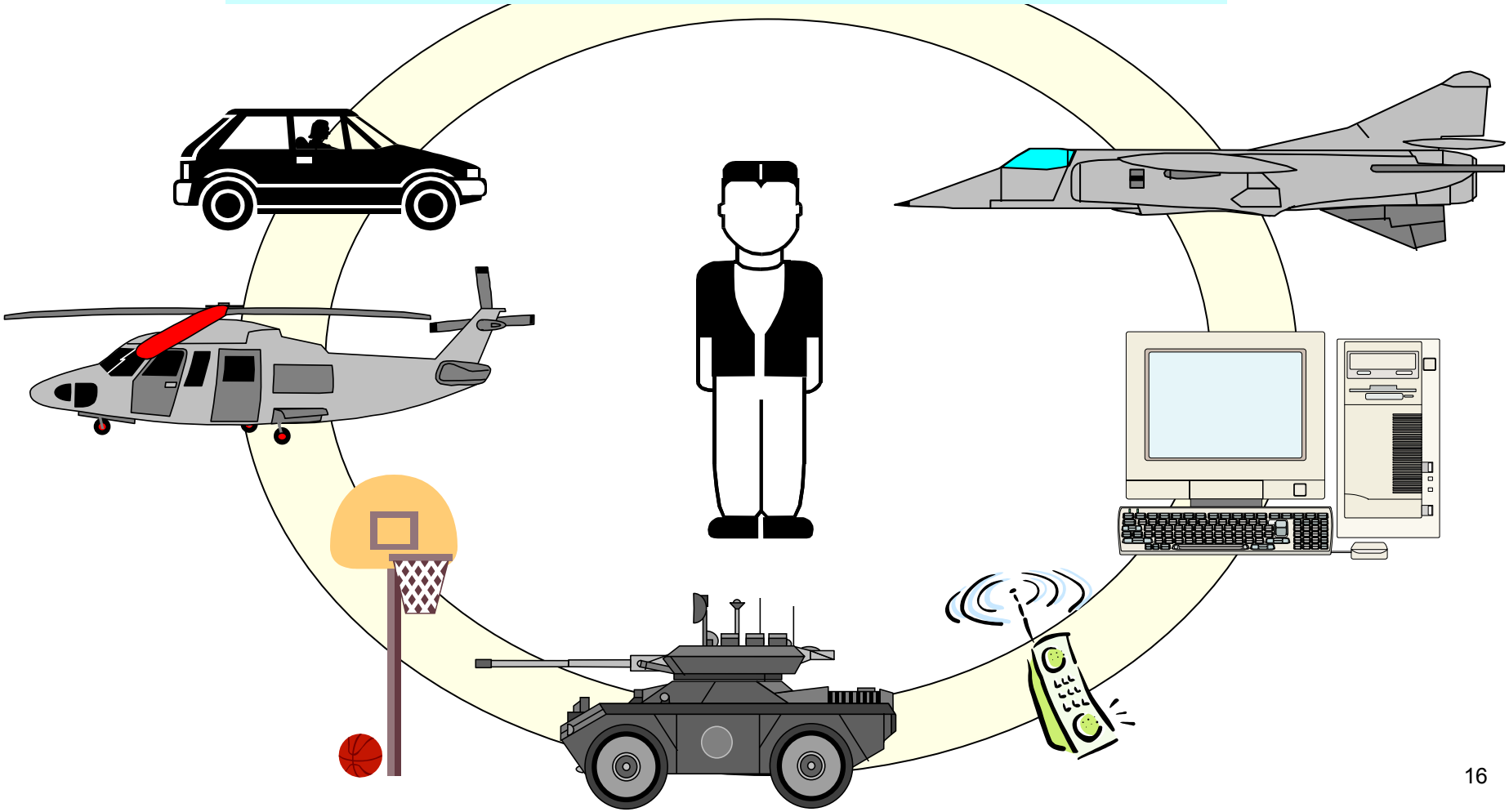
Too Dangerous

Field Study Not Feasible

Model – Test – Model

Why Human Performance Modeling?

System Performance = f(human performance)



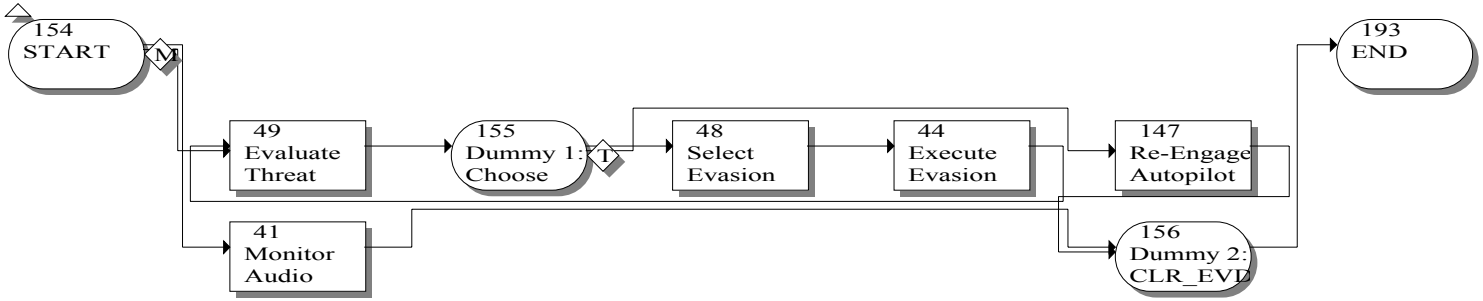
Task Network Human Performance Modeling

INPUTS

- Time and accuracy of each task
- Consequences of "poor" performance

Gathered from such sources as existing data, algorithms, and estimates from SMEs

MODEL

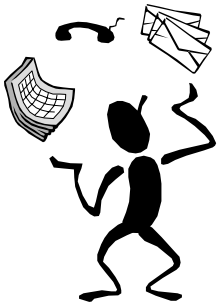


OUTPUTS

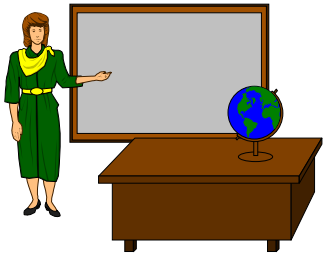
Measures of effectiveness

Not descriptive models, but predictive models

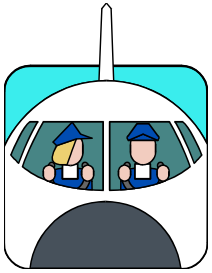
What Does Human Performance Modeling Tell Us?



Is the human overloaded with tasks?



Will training improve human and system performance?

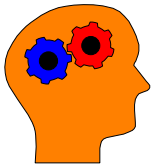


How to allocate tasks between human(s) and automation?

What are the performance tradeoffs with different system designs or levels of operator experience?

Typical Measures

Task time and accuracy



Operator workload level

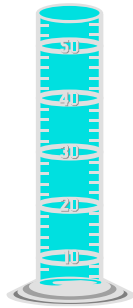
Number of operators required

Impact on System Performance

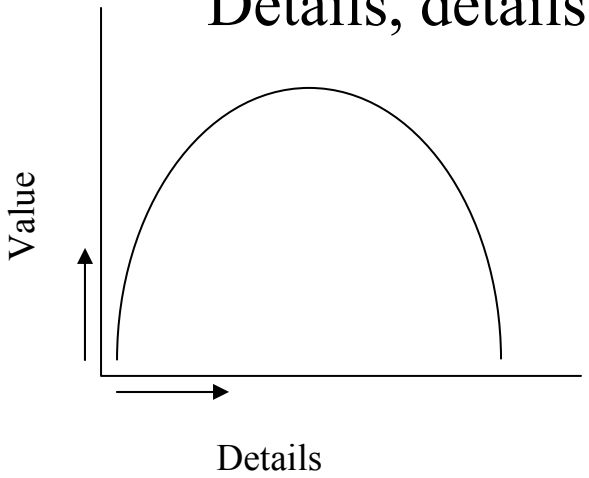
Challenges to Human Performance Modeling

Clear questions

Appropriate measures



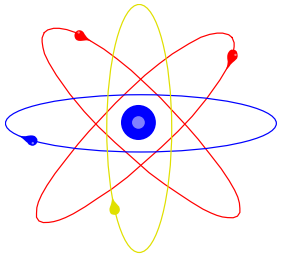
Details, details, details

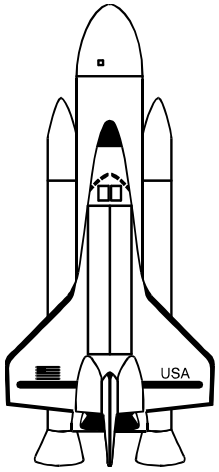


Input data collection

Scientific Method

- Determine the problem - What is your question? Observation!
- Make a hypothesis - What is your prediction?
- Test your hypothesis - What steps and measures are necessary? What tool?
- Analyze your results
- Draw conclusions





McLaughlin, C.W. and Thompson, M. (1999). Physical Science. Columbus, OH: Glencoe/McGraw-Hill.

Loading the Software

System Requirements

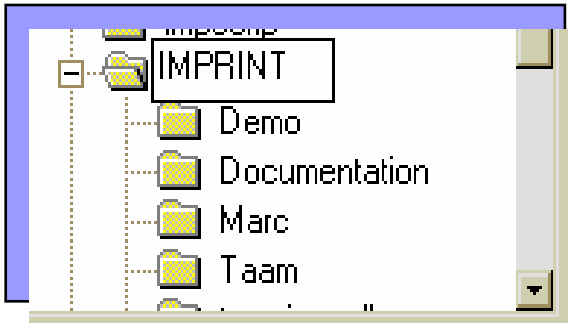
- Pentium
- 64 MB RAM – Minimum
- 100 MB disk space
- VGA
- Windows 95/98 or Windows NT/2000/XP
- Office for enhanced reporting & graphing

Installing IMPRINT

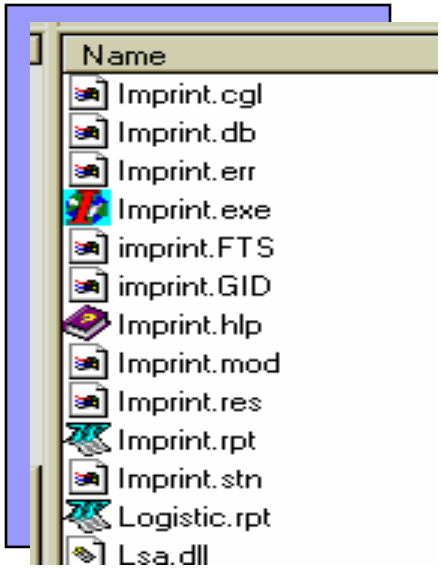
- Installs from CD to hard drive
- Installation procedure determines the correct DLLs to install
- Default directory: C:\IMPRINT

IMPRINT Basics

The IMPRINT Directory



- What's in it
  - Executable files, & DLL files
  - IMPRINT database files
    - » "library" files - stuff that "comes with" IMPRINT
    - » "user" files - your stuff
    - » "working" or "session" files - for the open analysis
  - Report files - linked to an analysis
  - Help files
  - Documentation & Readme
    - » Analysis Guide & User's Guide



- What isn't: Your analysis by name!

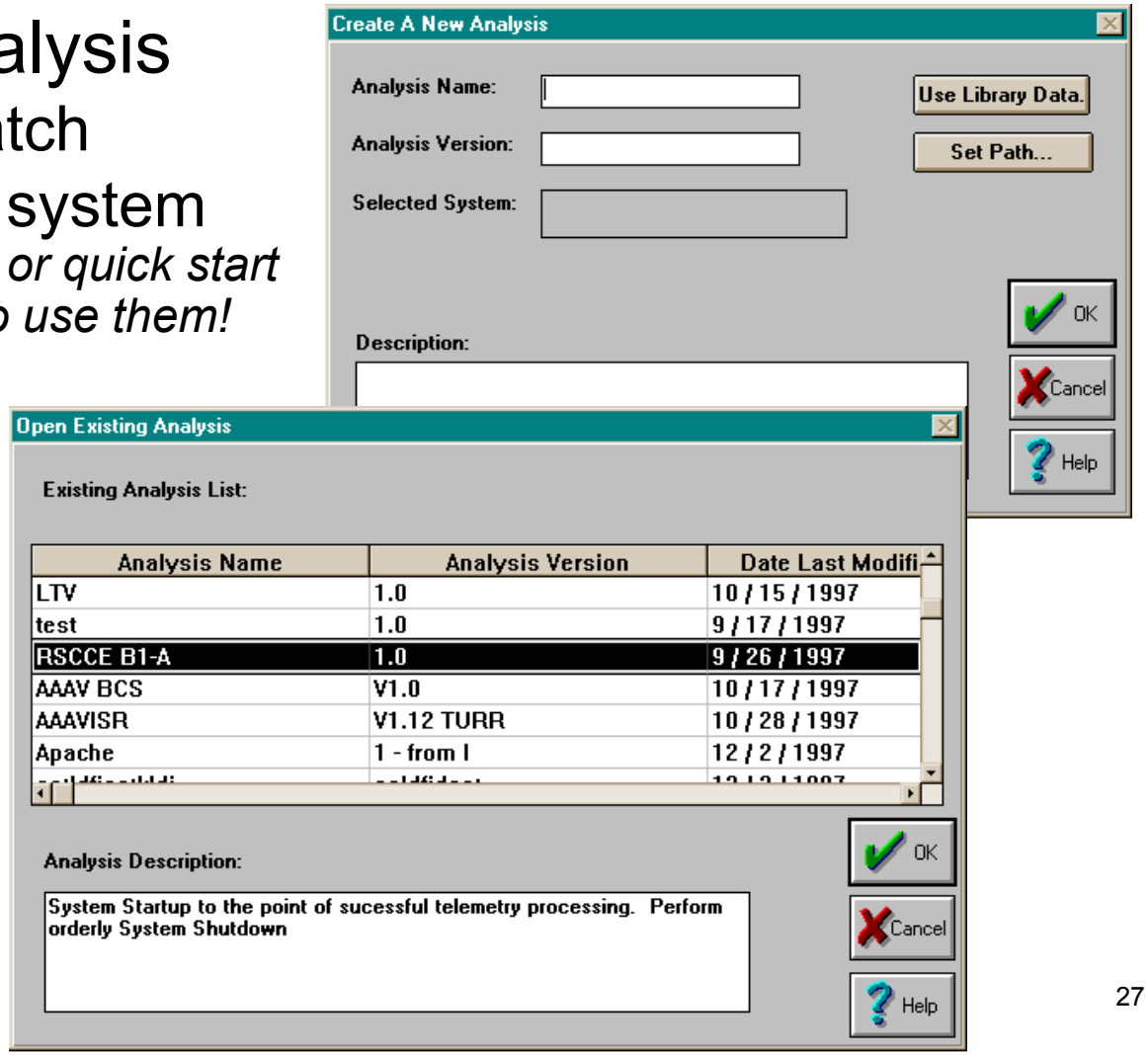
What Your Analysis Looks Like

When you open IMPRINT you will -

- Create a new analysis
  - Starting from scratch
  - Or using a library system

  Libraries are for reference or quick start
  But you are not required to use them!

- Or open an existing one



The IMPRINT Library

Mission Area	System Type	System
Air Defense	Air Defense Mobile Gun	M163 VULC
Air Defense	HIMAD	Patriot FP
Air Defense	Man-port Air Defense Sys	STINGER
Aviation	Attack Helicopter	AH-64A
Aviation	Cargo Helicopter	CH-47D
Aviation	Scout Helicopter	OH-58D
Aviation	Utility Helicopter	UH-60A
Close Combat Heavy	Cavalry Fighting Vehicle	M3 BRADLEY
Close Combat Heavy	Tank	M1 ABRAMS
Close Combat Light	Anti-tank Vehicle	M901 ITV
Close Combat Light	Automatic Weapon	M249 SAW
Close Combat Light	Grenade Launcher	M203
Close Combat Light	Infantry Fighting Vehicle	M2 BRADLEY
Close Combat Light	Man-port. Anti-tank Wp	DRAGON
Close Combat Light	Man-port Indirect Fire Wp	M252 81MM
Close Combat Light	Rifle	M16A1
Combat Service Support	Heavy Truck	M977 HEMTT
Combat Service Support	Light Truck	M998 HMMWV
Fire Support	Med Range Missile Artill'y	LANCE
Fire Support	Rocket Field Artill'y System	MLRS
Fire Support	Self-propelled Howitzer	M109A2 HOW
Fire Support	Towed Howitzer	M102 HOW

OK

Cancel

?

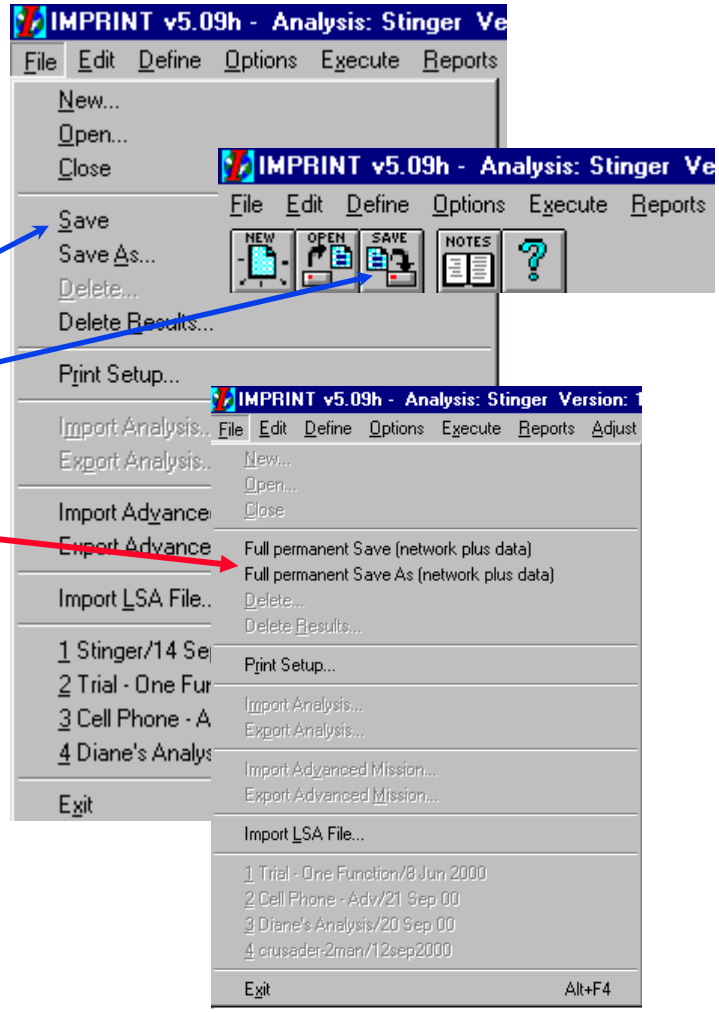
Embedded data include: task network, task times, workload, repair & failure times, soldier skill etc.

Navigating within IMPRINT

- Windows “standards” (to the extent possible)
  - OK goes back one and saves
  - Cancel also goes back one & does not save
  - Other buttons advance
- Deeply embedded windows
  - Navigate from top > down
  - At embedded levels, also navigate sideways
- Multiple ways to access data
  - Lists, graphics, spreadsheets

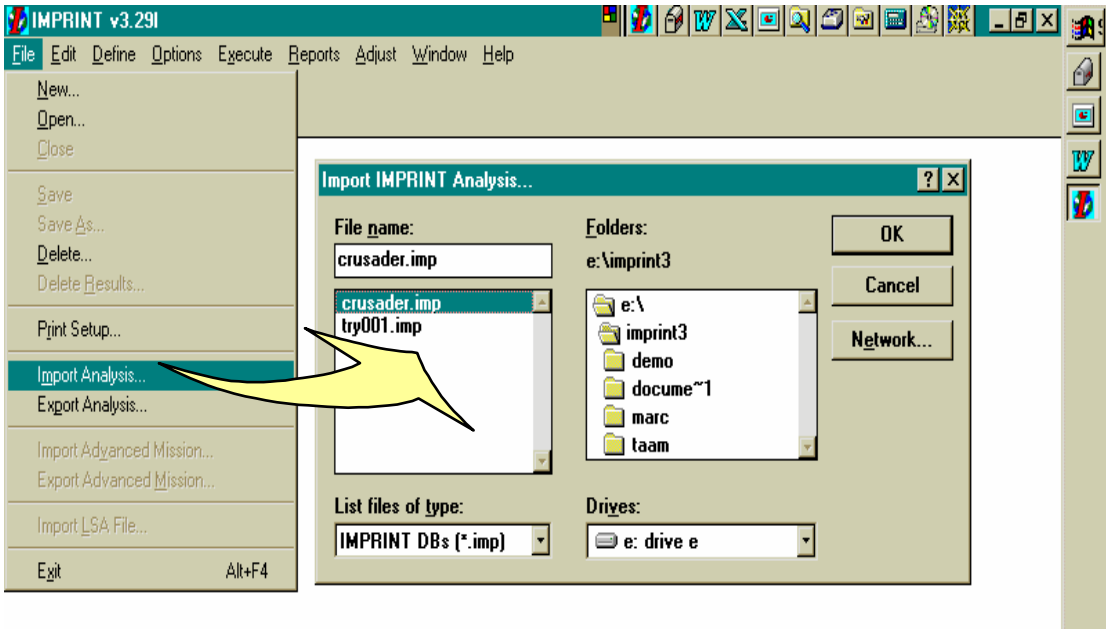
Saving Your Analysis

- Save early, save often*
  *from the top-most window
- Save again as you exit
- Saving your analysis
- Saving your network diagram & information
- When in doubt, save
- Reminders are legitimate!



Sharing Your Analysis Using Import & Export

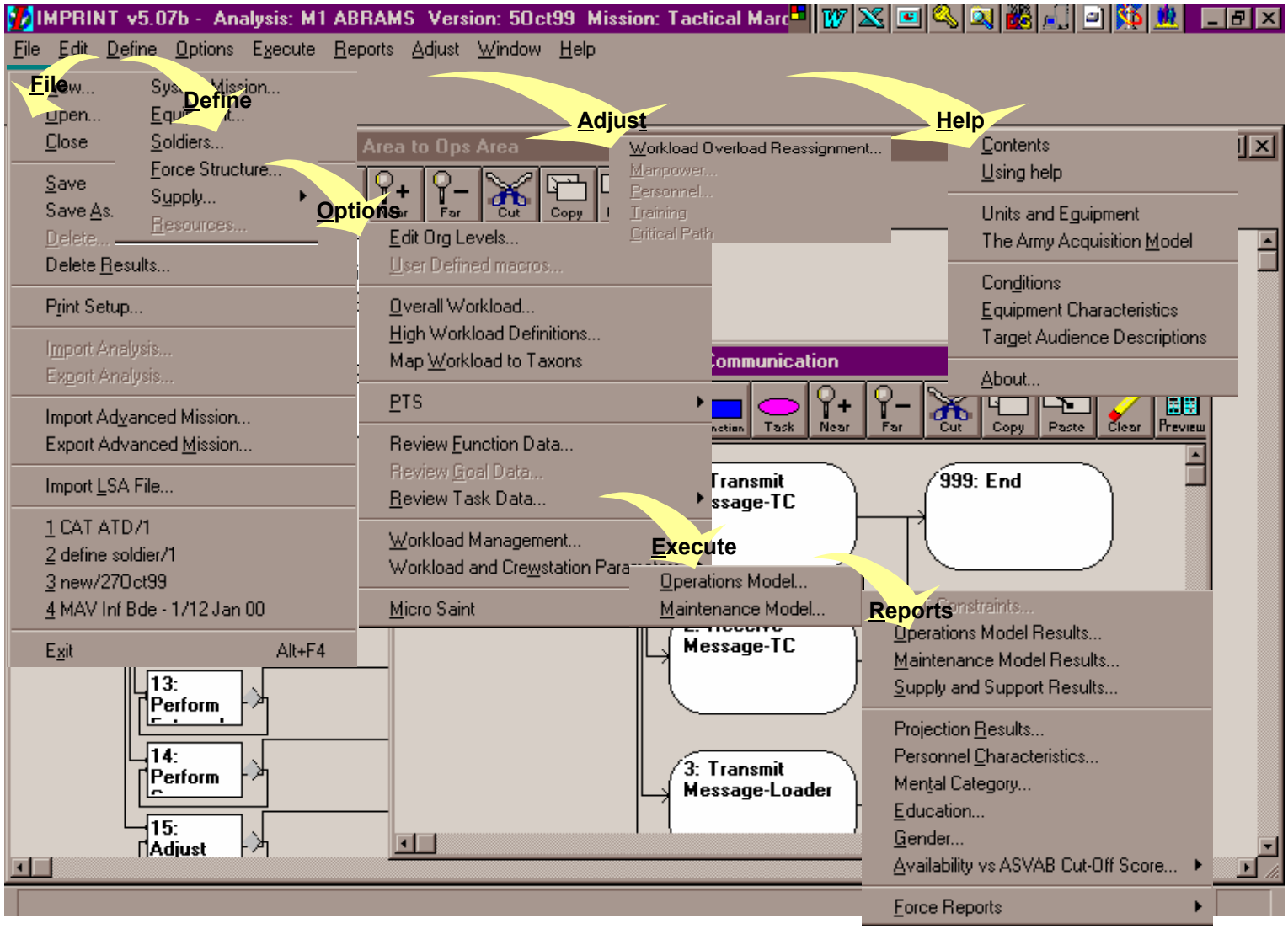
- To Import -
  - Close the open analysis
  - Select “Import”
  - Browse until you find the one you’re looking for
  - To access the analysis, you must then open it



- To Export -
  - Close your analysis if you have one open
  - Select Export option
  - Create export file using Windows naming conventions
  - On hard drive or on disk
  - File name does not have to = analysis name

In IMPRINT, it’s an analysis. Out of IMPRINT, it’s a .imp file.

IMPRINT Menus



IMPRINT Reports

Maintainer

Maintenance Model Reports

Scenario: Ten Days of Missions

Select the reports you wish to view:

- Maintenance Summary
- Daily Maintenance
- Reliability and Availability
- Maintenance Hit Matrix
- Daily Reliability

Maintenance Summary

Scenario	0	Ten Days of Missions
Total Operating Hours		3,200.00
Average Preventive Maintenance Hours		308.42
Average Corrective Maintenance Hours		8.93
Average Maintenance Per Operating Hour		0.10

Daily Maintenance

Day	Preventive	Corrective
1	25.91	1.21
2	21.59	0.07
3	7.92	1.0
4	20.09	1.2
5	14.80	1.2
6	10.31	0.2
7	27.94	0.2

Reliability and Availability

Availability Summary

Average Inherent Availability	99.95 %
Average Achieved Availability	99.29 %
Readiness	100.00 %

Maintenance Hit Matrix

Task Name	Type of Maint.	Level	MOS 1	No.	MOS 2	No.	Occurrences	ManHours
Remove & Replace	Preventive	ORG	68N20	2	67T20	1	14	10.50
Trouble Shoot	Preventive	ORG	68N20	1	68F20	1	5	3.30
Adjust & Repair	Preventive	ORG	68F20	1	67T20	1	1	0.26
Remove & Replace	Preventive	ORG	68N20	2	67T20	1	7	5.04
Trouble Shoot	Preventive	ORG	68N20	2	67T20	1	4	1.20
Adjust & Repair	Preventive	ORG	68N20	2	68F20	1	4	9.72
Adjust & Repair	Preventive	ORG	67T20	2	68N20	1	12	9.72
Remove & Replace	Preventive	ORG	67T20	2	68N20	1	25	18.00

Operator

Mission Performance

Mission 56 **Fly from Landing Zone (LZ) to Pickup Zone (PZ)**

Number of Times Performed: 10

	Standard	Minimum	Maximum	Mean	Standard Deviation	% Met
Time <=	00:42:00	00:29:05	00:30:33	00:29:40	00:00:26	100.00
Accuracy:						
Mission Time						
RESULT: Th						

Task Performance

RESULT: This does NOT meet the performance criterion of 85.00%.

Function: 9 Initiate Level Flight (LZ - PZ)

Task 2 Adjust Power

Operator Name: Pilot

Number of times performed: 10

	Standard	Minimum	Maximum	Mean	Std. Dev.	% Met
Time <=	00:00:04	00:00:01	00:00:01	00:00:01	00:00:00	100.00

Operator Workload

Operator	Time (Min)	Visual	Auditory	Cognitive	Psychomotor	Number
Pilot	0.000	1.00	1.00	4.70	0.00	2.00
Pilot	0.020	1.00	1.00	4.70	0.00	2.00
Pilot	0.030	1.00	5.90	10.00	0.00	3.00
	0.050	1.00	5.90	10.00	0.00	3.00
	0.060	0.00	4.90	5.30	0.00	1.00
	0.070	0.00	9.20	10.60	2.20	2.00
	0.080	1.00	9.20	11.80	2.20	3.00
	0.100	4.00	4.30	12.10	2.20	2.00
	0.120	4.00	4.30	12.10	2.20	2.00

Personnel Characteristics

AFQT

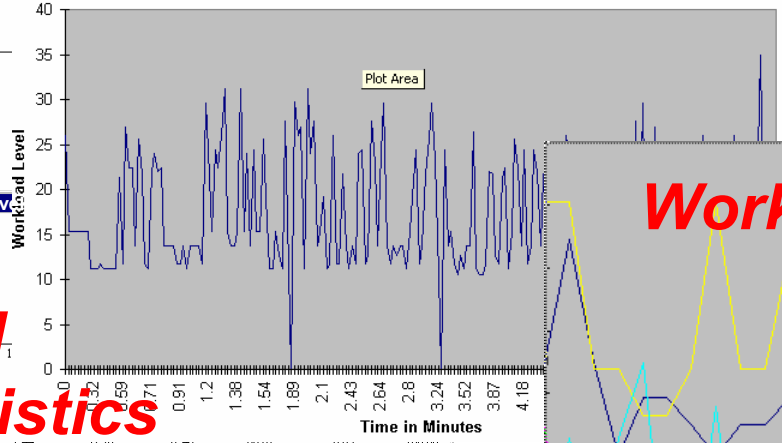
		I	II	IIIA	IIIB	IV	Total
	E1 - E3	10.00	84.00	81.00	44.00	6.00	225.00
	E4	16.00	190.00	148.00	97.00	26.00	477.00
MOS:	E5	4.00	110.00	71.00	71.00	19.00	275.00
67R	E6	5.00	97.00				
	E7	6.00	62.00				
	E8 - E9	0.00	0.00				
	Total	41.00	543.00				

		I	II
	E1 - E3	35.00	135.00
	E4	10.00	171.00
MOS:	E5	5.00	73.00
68B	E6	1.00	30.00
	E7		
	E8 - E9		
	Total		

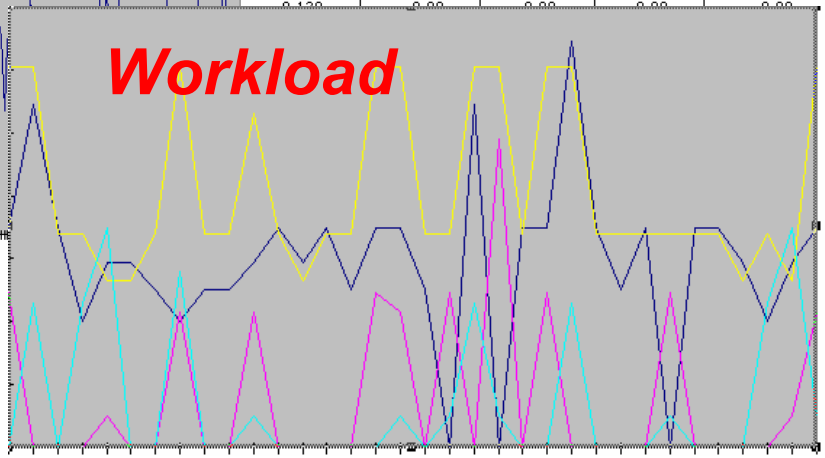
1 of 3

Reading Grade Level

	E1 - E3						
	E4						
MOS:	E5						
67R	E6						
	E7						
	E8 - E9						
	Total						
	E1 - E3						
	E4						
MOS:	E5						
68B	E6	0.64	16.64	16.42	40.71	1.59	76.00



Workload



Define Mission

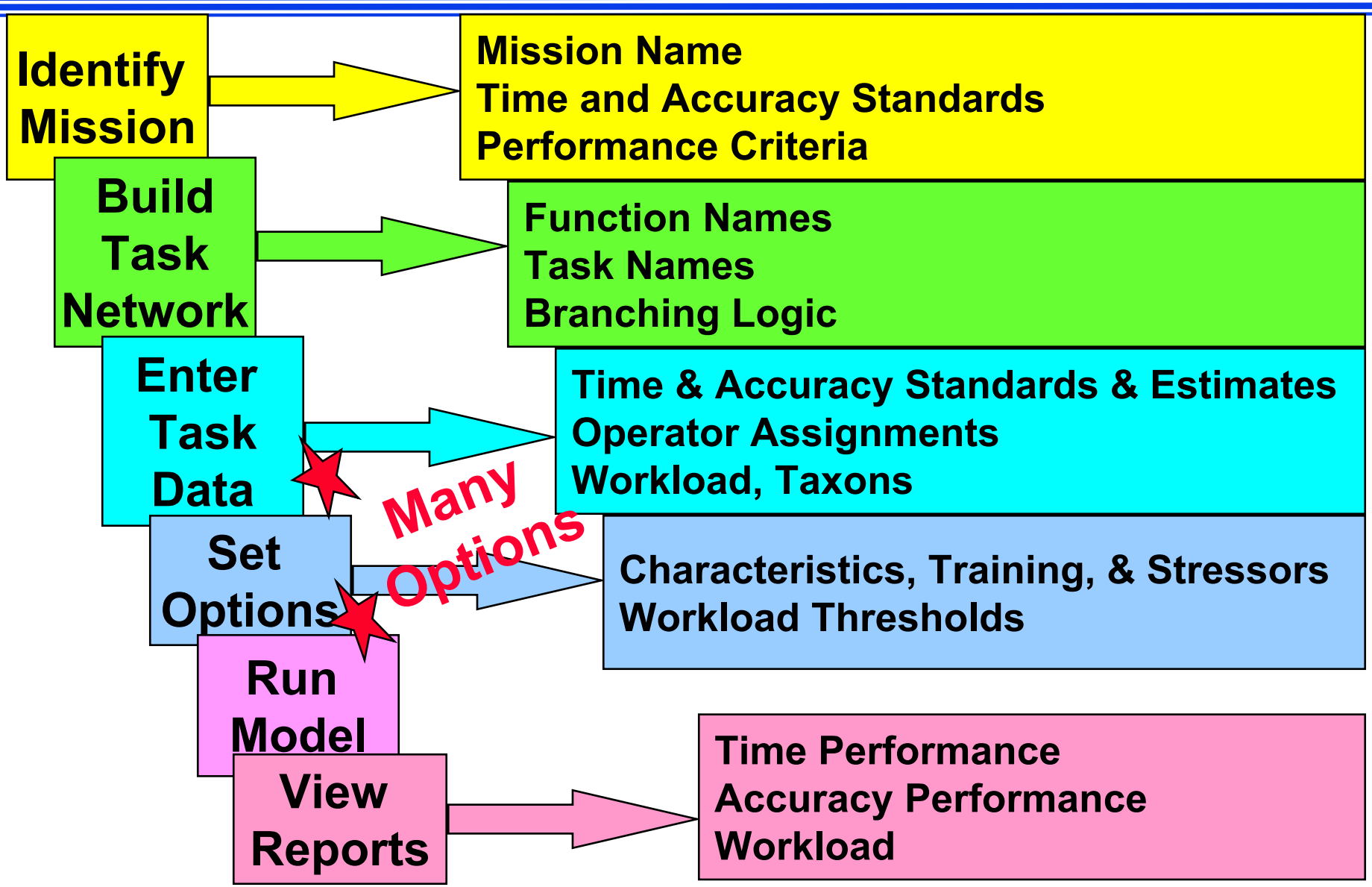
Define Mission Answers...

- How long will it take to perform my tasks?
- How much workload will be created?
- What is the probability of success?
- How should tasks be allocated across crewmembers and to automation?

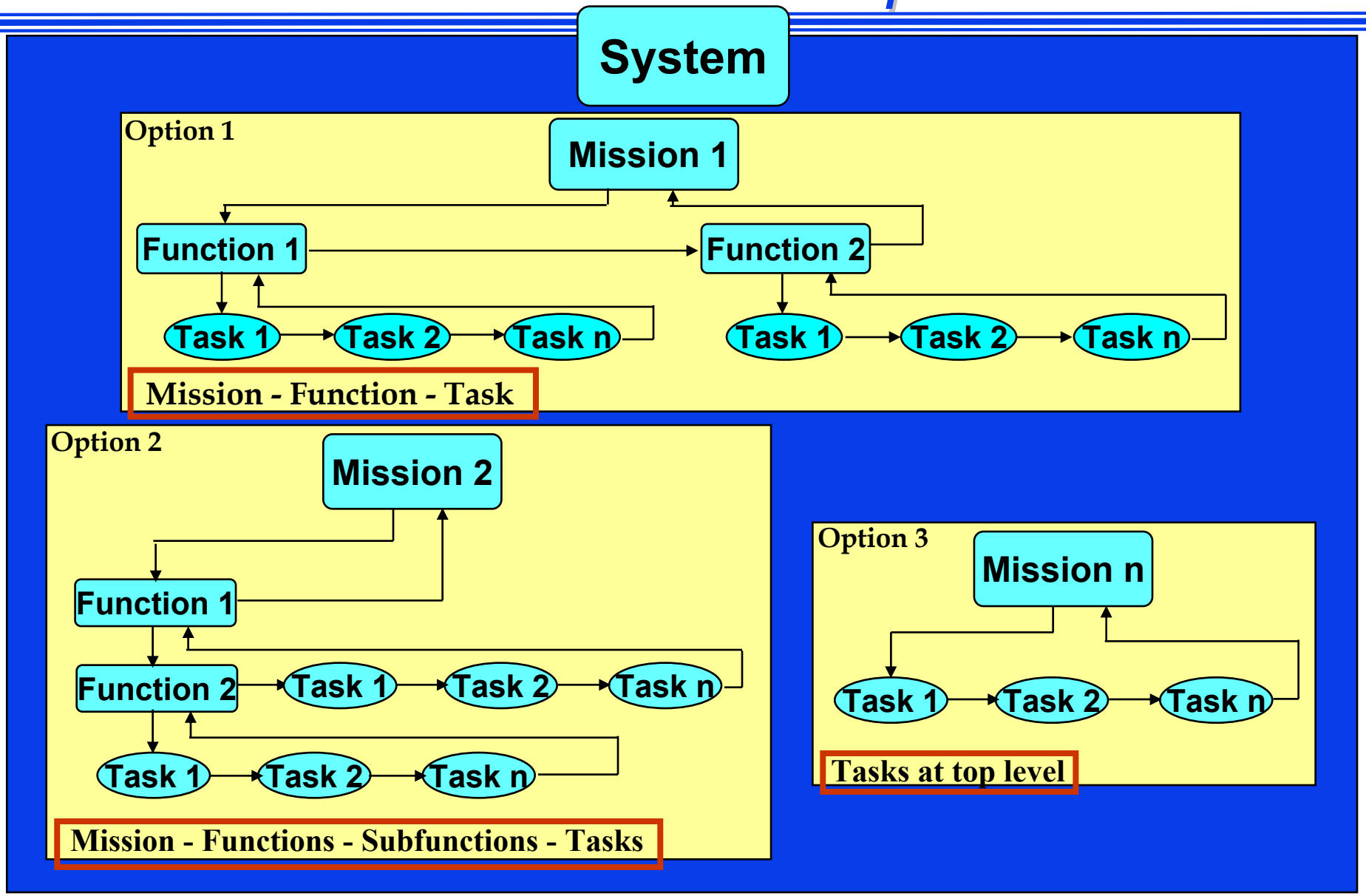
Define Mission Inputs

- Mission level
  - time standard
  - time criterion
  - accuracy criterion
  - mission criterion
- Function level
  - time standard
  - time criterion
- Branching logic
  - serial
  - multiple
  - repeating
  - probabilistic
- Task level
  - time standard
  - accuracy standard
  - criterion
  - time estimate
  - accuracy estimate
  - consequences of failure
  - workload
  - taxons
  - crew assignments

Define Mission Process



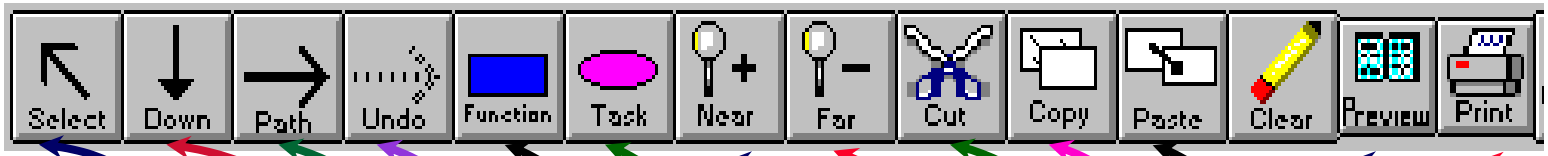
Task Network Hierarchy Options in VACP



Define Mission

- Micro Saint-based modeling tool
- Designed specifically for human operators of systems
- Evaluate system performance time and/or accuracy
- Has workload computations built-in
- Has data collection built-in

Task Network Toolbar



selects a node

displays next level down

draws a path

erases a path

places a function node

places a task node

zooms in

zooms out

cuts a node (can paste)

copies a node

pastes a node

clears a node (can't paste)

shows page layout

prints the diagram

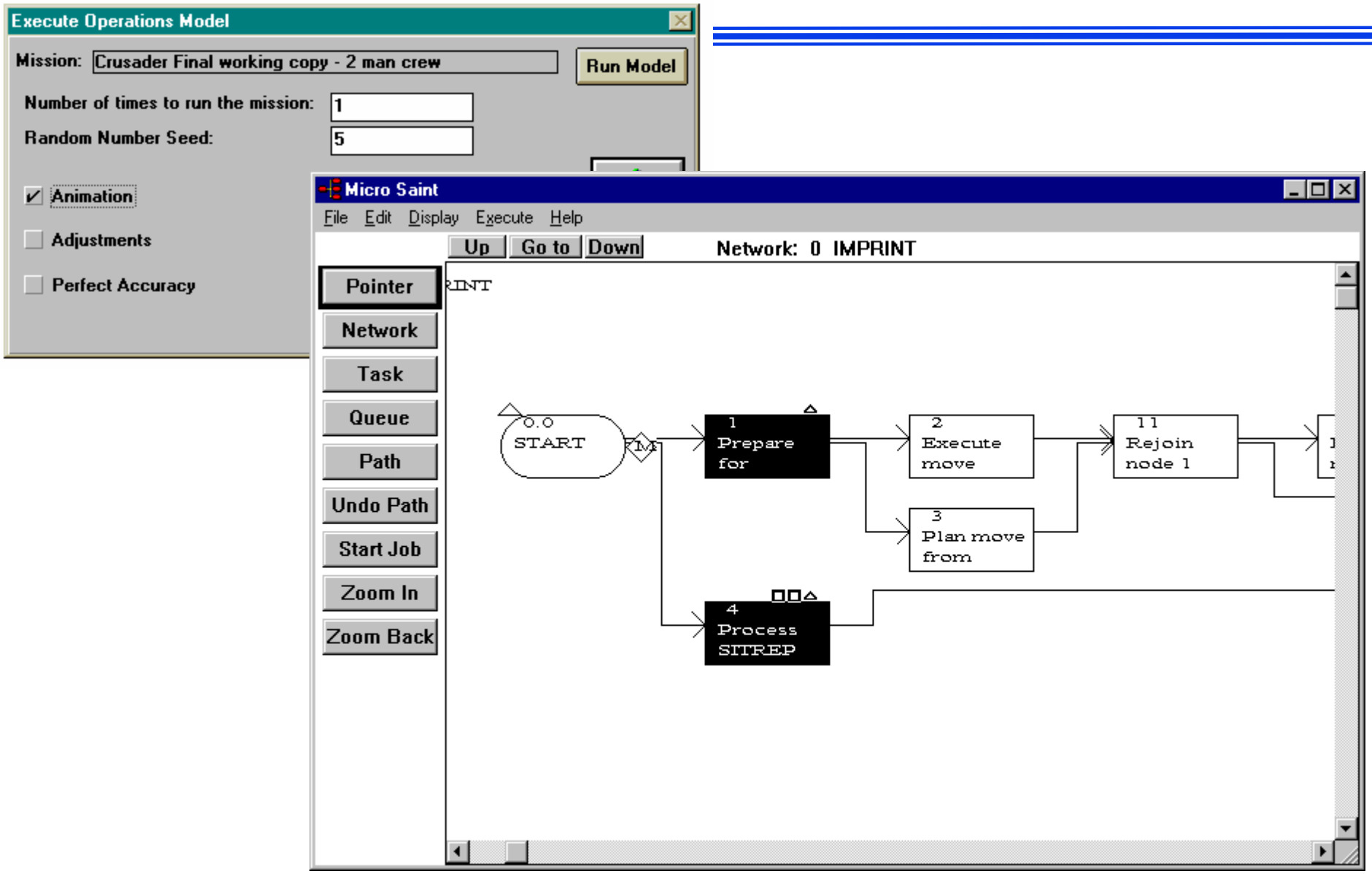
Enter Task Data

- Time
  - Standard
  - Mean & Standard Deviation
  - Micromodels
- Accuracy
  - Standard
  - Probability of Success
  - Mean & Standard Deviation
  - Consequences of Failure
- Operator assignments
- Workload
- Taxons

Assign Operators to Tasks

- Primary
  - Performs task regardless of current workload
- Secondary (Optional)
  - Has requisite skills and training
  - Used to recommend task reallocations

Run Model


Execute Operations Model
Mission:
Crusader Final working copy - 2 man crew
Run Model
Number of times to run the mission:
1
Random Number Seed:
5
Animation
Adjustments
Perfect Accuracy
Micro Saint
File Edit Display Execute Help
Up
Go to
Down
Network: 0 IMPRINT
Pointer
Network
Task
Queue
Path
Undo Path
Start Job
Zoom In
Zoom Back
0.0
START
1
Prepare for
2
Execute move
11
Rejoin node 1
3
Plan move from
4
Process SITREP

Outputs of Define Mission

- Mission Performance
  - Predicted time & success rate
- Function Performance
  - Predicted time
- Task Performance
  - Predicted time & accuracy
- (And others you will see later)

Cashier Model

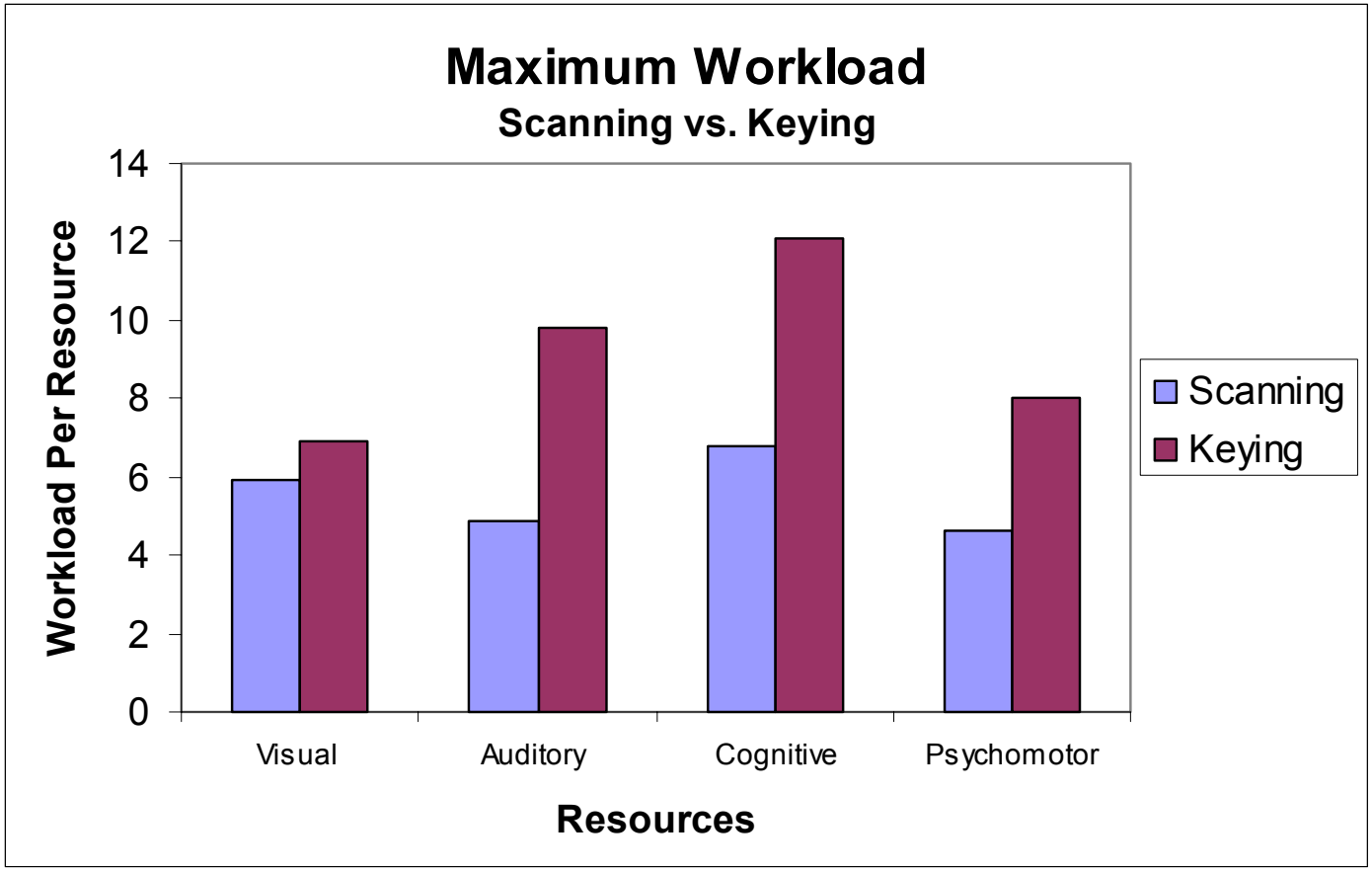
Results - Spreadsheets

			Operator Workload			
System:			March 31, 2003			
Mission:	Chatty Cashier keying items					
Operator	Time	Visual	Auditory	Cognitive	Psychomotor	Overall
Cashier	00:00:00.00	1	1	1	1	4
Cashier	00:00:00.70	3.7	4.9	1	1	10.6
Cashier	00:00:03.10	6	4.9	6.3	5.6	22.8
Cashier	00:00:04.60	6	5.9	**9**	**8**	28.9
Cashier	00:00:06.10	6	5.9	**9**	**8**	28.9
Cashier	00:00:06.70	5	4.9	**12.1**	5.6	27.6
Cashier	00:00:06.76	4.7	4.9	**9.9**	1	20.5
Cashier	00:00:06.84	2	4.9	6.3	5.6	18.8
Cashier	00:00:06.94	6	4.9	6.3	5.6	22.8
Cashier	00:00:08.44	6	5.9	**9**	**8**	28.9
Cashier	00:00:09.10	6	5.9	**9**	**8**	28.9
Cashier	00:00:10.53	5	4.9	**12.1**	5.6	27.6
Cashier	00:00:10.60	2	4.9	5.3	5.6	17.8
Cashier	00:00:11.10	4.7	4.9	6.3	5.6	21.5
Cashier	00:00:12.10	2	4.9	6.3	5.6	18.8
Cashier	00:00:12.20	6	4.9	6.3	5.6	22.8
Cashier	00:00:13.70	6	5.9	**9**	**8**	28.9
Cashier	00:00:15.10	6	5.9	**9**	**8**	28.9
Cashier	00:00:15.79	5	4.9	**12.1**	5.6	27.6
Cashier	00:00:15.85	4.7	4.9	**9.9**	1	20.5
Cashier	00:00:15.93	2	4.9	6.3	5.6	18.8
Cashier	00:00:16.03	6	4.9	6.3	5.6	22.8

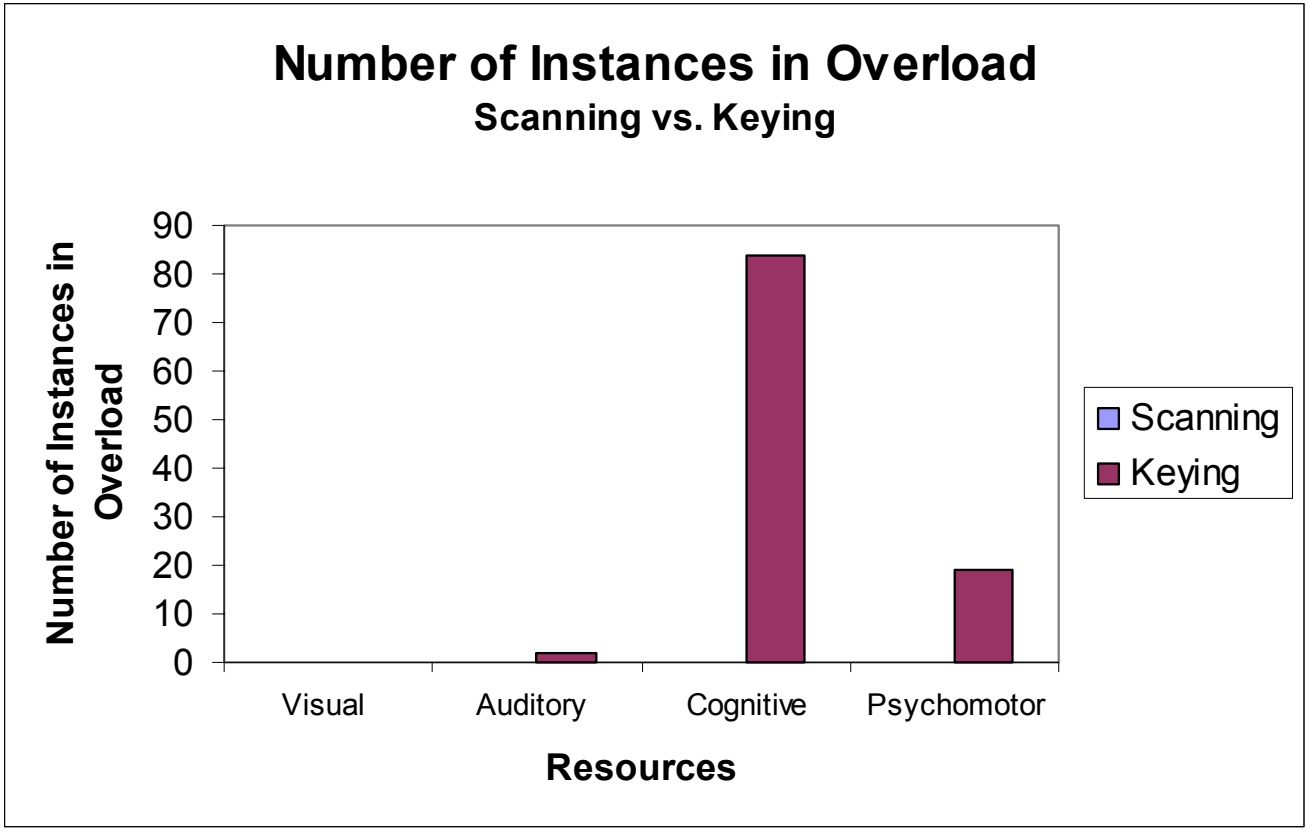
Results - tables

	Max Value		Instances in Overload (# of times >7)	
Resources	**Scanning**	**Keying**	**Scanning**	**Keying**
Visual	5.9	6.9	0	0
Auditory	4.9	9.8	0	2
Cognitive	6.8	12.1	0	84
Psychomotor	4.6	8	0	19

Results - charts



Results - charts

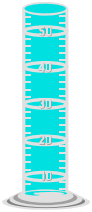


Develop Your Own Analysis

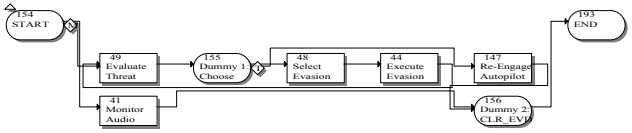
Develop Your Own Analysis

- Pick a Topic
- Develop a Question and Hypothesis

- Determine Measures



- Identify Functions and Tasks
- Build your Model



Your Model Analysis

Does Your Model Run?

Yeah!!

So what???

Your Model Runs – So What?

- **Did it do what you wanted it to?**
  - First step is verification and debugging
- **How are you going to evaluate the results?**
  - Complete the analysis step
- **Is this realistic?**
  - Validate the model

VV&A or V(A)V&A

Verification, Validation, and Accreditation
vs.
Verification, Analysis, Validation, and Accreditation

- **Verification** means determining that the model does what it was meant to do
- **Analysis** of results means evaluating the results
- **Validation** means the model adequately represents the system
- **Accreditation** means that the model has be accredited for the use case

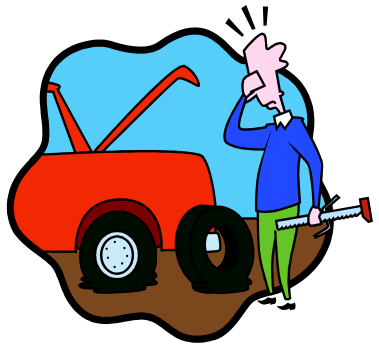
Tow Company - Example

They change a lot of tires. The number of tires changed equates to income. Maybe technology will help.

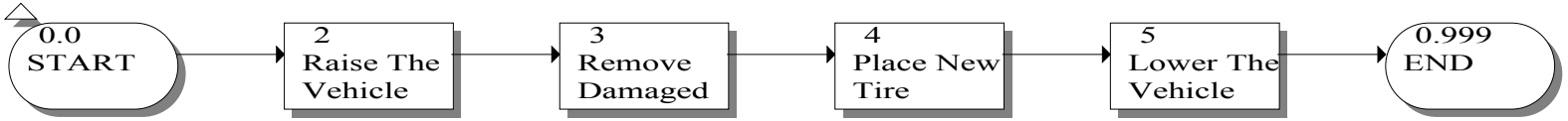
Questions: How long does it take to change a tire?
Where are the most errors made?

First step was to do a task analysis of tire changing and collect time and accuracy data.

Build a model.



Tire Change Model



Tire Change Model – 10 runs

Task	No of times normally executed in a run	No. of Times Executed	Time Std	Mean Time	Std Dev	met Time Std.	Accuracy Std	met Accuracy Std.	Performance Criterion	met Criterion	Failed Criterion	mission aborts
Locate jack point	1	13	45	30.9	7.8	100	92	76.92	90	76.92	yes	
place jack	1	12	30	10.2	3.06	100	85	83.33	90	83.33	yes	
raise car	1	10	20	14.58	2.34	100	95	100	90	100	no	
loosen lug nuts	6	96	20	10.26	2.88	100	80	59.38	90	59.38	yes	1
raise car	1	9	20	11.64	3.84	100	95	100	90	100	no	
remove lug nuts	6	54	20	9.84	5.1	94.44	90	100	90	94.44	no	
remove tire	1	9	20	11.58	2.4	100	95	100	90	100	no	
align tire	1	10	20	11.04	3.48	100	90	100	90	100	no	
lift and place	1	10	15	5.82	2.64	100	90	90	90	90	no	
hand tighten lug nuts	6	77	30	13.68	5.64	100	75	70.13	90	70.13	yes	
lower vehicle	1	9	20	10.92	3.72	100	95	100	90	100	no	
remove jack	1	9	10	5.58	1.56	100	95	100	90	100	no	
tighten lug nuts	6	69	30	15.42	4.68	100	95	78.26	90	78.26	yes	
Mission	1	10	9:00	8:37.98	51.72	70		90	95	60	yes	

Tire Change Model – 30 runs

Task	No of times normally executed in a run	No. of Times Executed	Time Std	Mean Time	Std Dev	met Time Std.	Accuracy Std	met Accuracy Std.	Performance Criterion	met Criterion	Failed Criterion	mission aborts
Locate jack point	1	34	45	29.46	12.6	94.12	92	88.54	90	82.35	yes	
place jack	1	56	30	10.02	3.12	100	85	53.57	90	53.57	yes	
raise car	1	30	20	15.54	4.56	86.67	95	100	90	86.57	yes	
loosen lug nuts	6	279	20	9.78	3.3	100	80	61.65	90	61.65	yes	3
raise car	1	28	20	10.44	3.48	100	95	96.43	90	96.43	no	
remove lug nuts	6	164	20	10.02	5.04	96.34	90	98.78	90	95.12	no	
remove tire	1	27	20	10.56	3.66	100	95	100	90	100	no	
align tire	1	34	20	10.8	4.2	97.06	90	91.18	90	88.24	yes	
lift and place	1	34	15	5.16	2.4	100	90	79.41	90	79.41	yes	
hand tighten lug nuts	6	162	30	14.82	4.62	99.53	75	76.42	90	75.94	yes	
lower vehicle	1	27	20	8.22	3.78	100	95	100	90	100	no	
remove jack	1	27	10	4.62	1.8	100	95	100	90	100	no	
tighten lug nuts	6	179	30	14.94	4.74	100	95	86.03	90	86.03	yes	3
Mission	1	30	9:00	8:16.02	52.98	83.33		80	95	63.33	yes	

Workload Concepts

Focus

What Is Mental Workload?

An Example

- Drivers slowing down to talk on their cell phone
- Accident rates of drivers using cell phones approaches that of drivers under the influence of alcohol

Why You Should Care About Workload

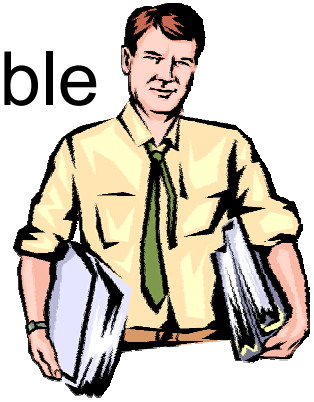
- If you reduce crewsize then some tasks must be automated or redistributed among remaining crew positions
  - Reallocation of tasks is likely to increase workload, thus increasing the potential for performance failures and errors.
  - Poorly designed automation can also increase workload and thus the potential for human errors.

Mental Workload Issues

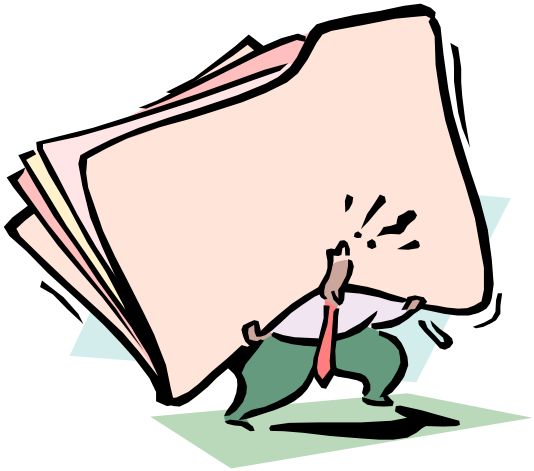
- Sustained low workload (underload) leads to boredom, loss of situation awareness, and reduced alertness.
- Sustained high workload (overload) leads to fatigue.
- Workload peaks lead to dropped tasks, increased task time, cognitive tunneling, and increased errors.
- These factors reduce crew performance, system performance, and contribute to mission failure

Mental Workload Objective

Achieve evenly distributed, manageable workload.

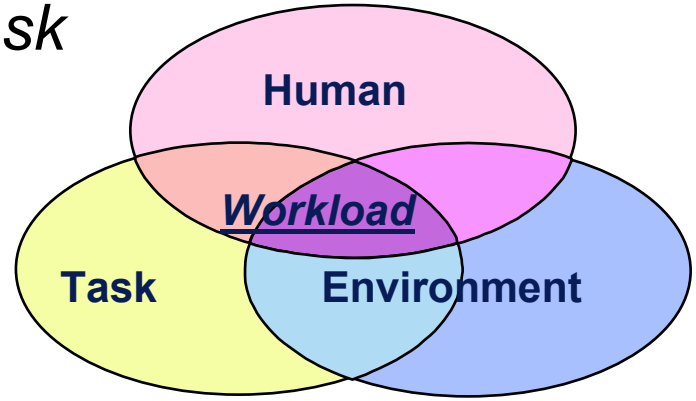


Avoid both overload and underload.



Mental Workload

- Workload Definition
  - There is no universally agreed-upon definition
  - Today, however, there is generally agreement that, essentially, workload is
    - » *the perceived relationship between the amount of mental processing capacity or resources and the amount required by the task*



*Gopher & Donchin, 1986, Hart & Staveland, 1988

Various Mental Workload Measurement Approaches

empirical

- physiological
- primary task
- secondary task
- subjective rankings

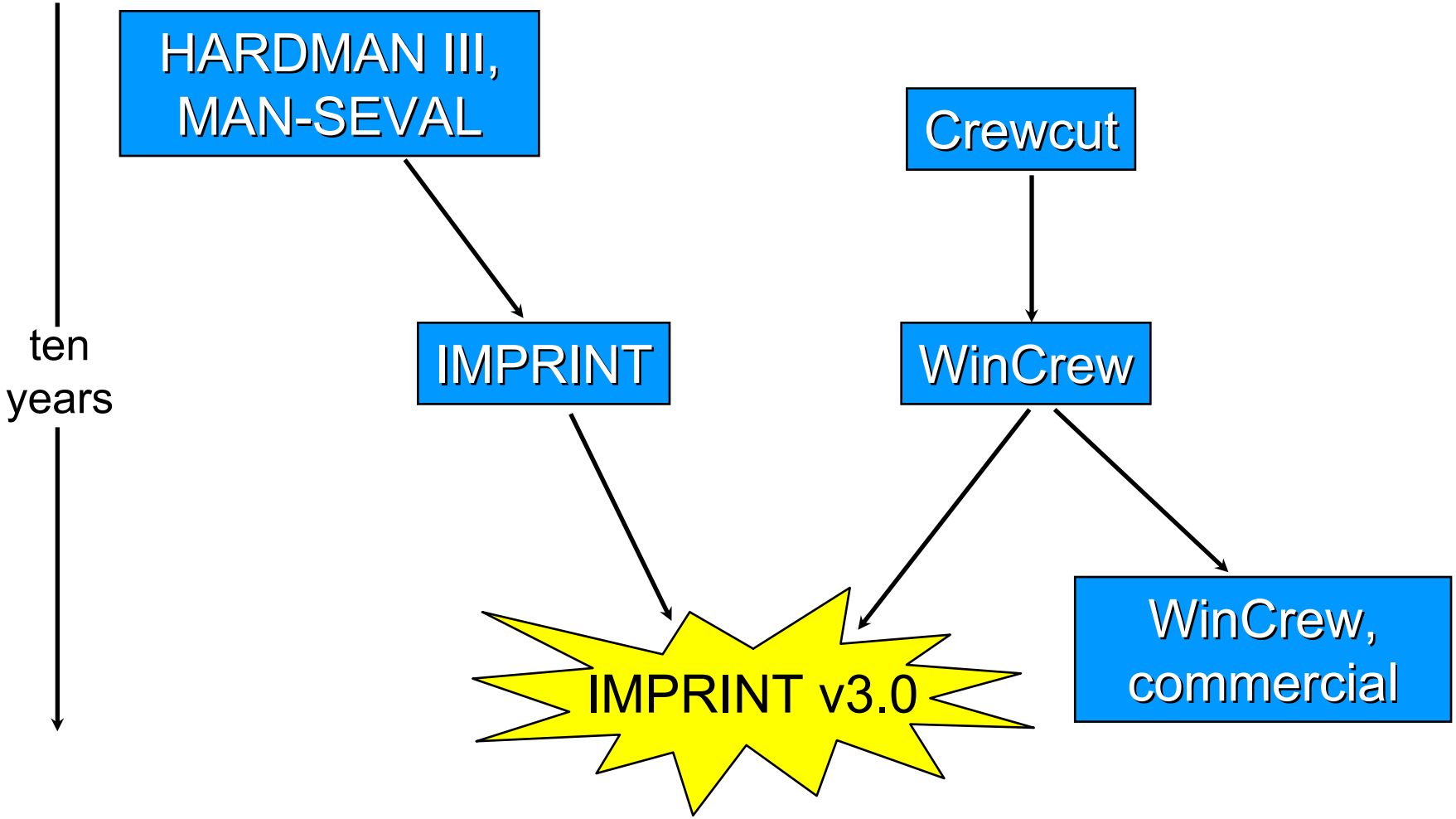
analytical

- workload modeling- IMPRINT

Workload Modeling

- Workload modeling of human behavior is a technique that has been used to *predict* workload levels.
  - IMPRINT can be used to model and predict mental workload.

ARL HRED Workload Modeling Tools



VACP Workload

VACP Workload Method

- AKA “McCracken-Aldrich
- Four independent channels
- Overload defined as any channel > 7
- Option to combine into “Overall” channel

Multiple Resources Theory of Mental Workload

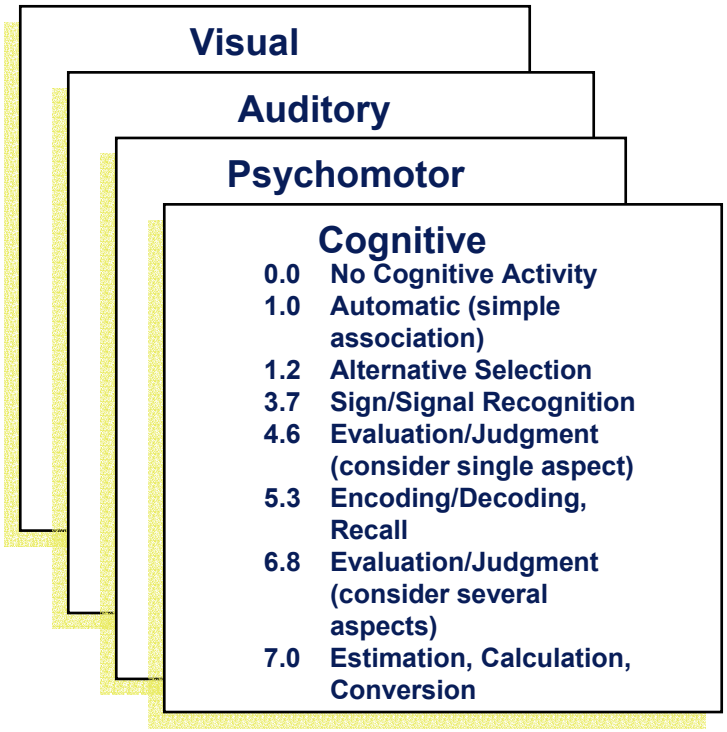
Mission Tasks → **Which Brain Resources Involved?** → **Degree of Resource Use?**

1. monitor alarms
2. decide response action
3. pull trigger

.
.
.

n. task n

- Visual
- Cognitive
- Auditory
- Psychomotor



Assign Workload

Visual

0.00 No Visual Activity
1.00 Visually Register/Detect (detect image)
3.70 Visually Discriminate (detect visual differences)
4.00 Visually Inspect/Check (static inspection)
5.00 Visually Locate/Align (selective orientation)
5.40 Visually Track/Follow (maintain orientation)
5.90 Visually Read (symbol)
7.00 Visually Scan/Search/Monitor(continuous)

Auditory

0.00 No Auditory Activity
1.00 Detect/Register Sound
2.00 Orient to Sound (general orientation)
4.20 Orient to Sound (selective orientation)
4.30 Verify Auditory Feedback
4.90 Interpret Semantic Content (speech)
6.60 Discriminate Sound Characteristics
7.00 Interpret Sound Patterns (pulse rate, etc.)

Assign Workload

Cognitive

0.00 No Cognitive Activity
1.00 Automatic (simple association)
1.20 Alternative Selection
3.70 Sign/Signal Recognition
4.60 Evaluation/Judgment (consider single aspect)
5.30 Encoding/Decoding, Recall
6.80 Evaluation/Judgment (consider several aspects)
7.00 Estimation, Calculation, Conversion

Psychomotor

0.00 No Psychomotor Activity
1.00 Speech
2.20 Discrete Actuation (button, toggle, trigger)
2.60 Continuous Adjustive (flight or sensor control)
4.60 Manipulative
5.80 Discrete Adjustive (rotary, thumbwheel, lever)
6.50 Symbolic Production (writing)
7.00 Serial Discrete Manipulation (keyboard entries)

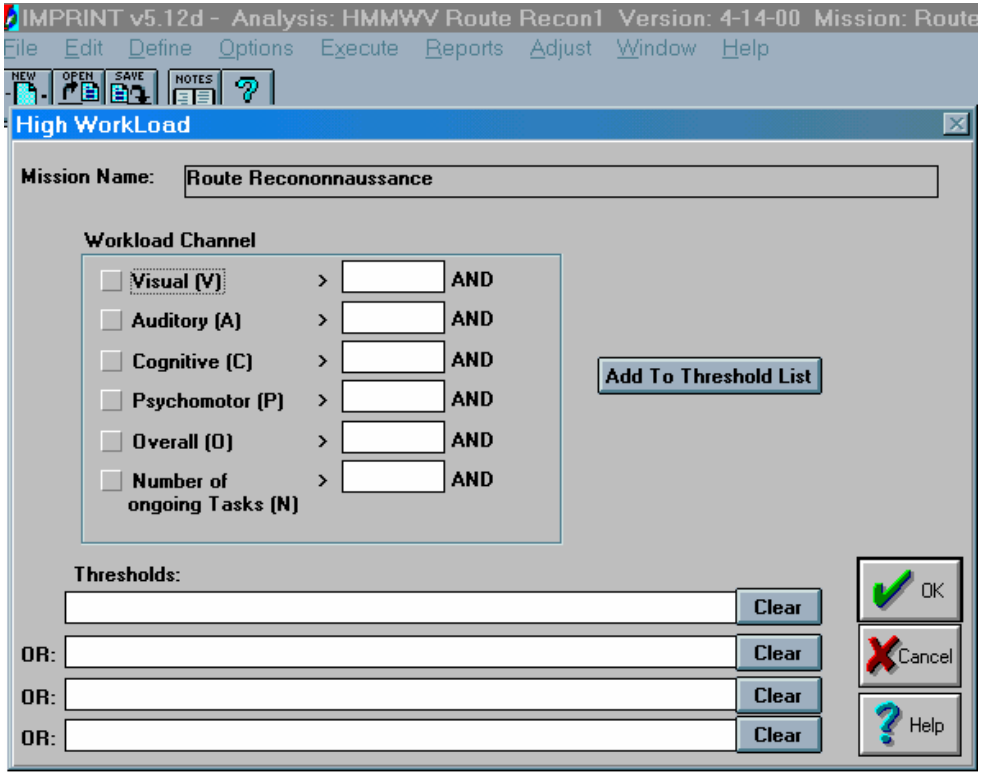
Subjective Assessment & Prediction: McCracken-Aldrich

- Originally developed for the LHX single-pilot helicopter program
- Consistent with Wickens multiple-resource theory
- Four original scales
  - Visual
  - Auditory
  - Cognitive
  - Psychomotor

"High Workload" and Reallocation

- Under "Options," define up to 5 high workload thresholds
- When model runs, points where one or more thresholds are exceeded will be reported
- Under "Adjust," workload overload points can be reviewed, and assigned to a secondary operator if desired
- Then re-run model to re-check workload

(Be sure to save your original model before reallocating)
(And remember, workload does not dynamically affect performance here)



Analysis of Results

FCS - 2 Vs. 3 Trade Study

FCS Modeling Team

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Mental Workload

Mission Tasks → **Which Brain Resources Involved?** → **Degree of Resource Use?**

1. monitor alarms
2. decide response action
3. pull trigger

.
.
.

n. task n

- **Visual**
- **Cognitive**
- **Auditory**
- **Psychomotor**

→

Visual

Auditory

Psychomotor

Cognitive

0.0	- No Cognitive Activity
1.0	- Automatic (simple association)
1.2	- Alternative Selection
3.7	- Sign/Signal Recognition
4.6	- Evaluation/Judgment (consider single aspect)
5.3	- Encoding/Decoding, Recall
6.8	- Evaluation/Judgment (consider several aspects)
7.0	- Estimation, Calculation, Conversion

Common Functions in Modeling Military Systems

Communicate information

Drive vehicle

Scan for targets

Command troops

Identify targets

Shoot targets

Maintain situation awareness

FCS Modeling Approach

Four IMPRINT combat models:

Gunner-Driver and Commander

Commander-Driver and Gunner

Commander-Gunner and Driver

Commander, Driver and Gunner

Crew Member Function Allocation

Function Name	Condition 1 GD and C	Condition 2 CD and G	Condition 3 CG and D	Condition 4 C and G and D
	Function allocation	*Function allocation*	*Function allocation*	*Function allocation*
Drive	GD	CD	D	D
Hindrance	GD	CD	D	D
Remediate	GD	CD	D	D
Engage	GD (C)	G (CD)	CG	G (C)
Scan	C	G	CG	C and G
External Com	C	CD	CG	C
Crew Commo	GD & C	CD & G	CG & D	C & G & D

FCS Modeling Results Summary

Commander - Driver and Gunner

Highest workload of all conditions

↓

Gunner - Driver and Commander

No shooting on the move

↓

Commander - Gunner and Driver

Best two crewmember function allocation; single vehicle commander

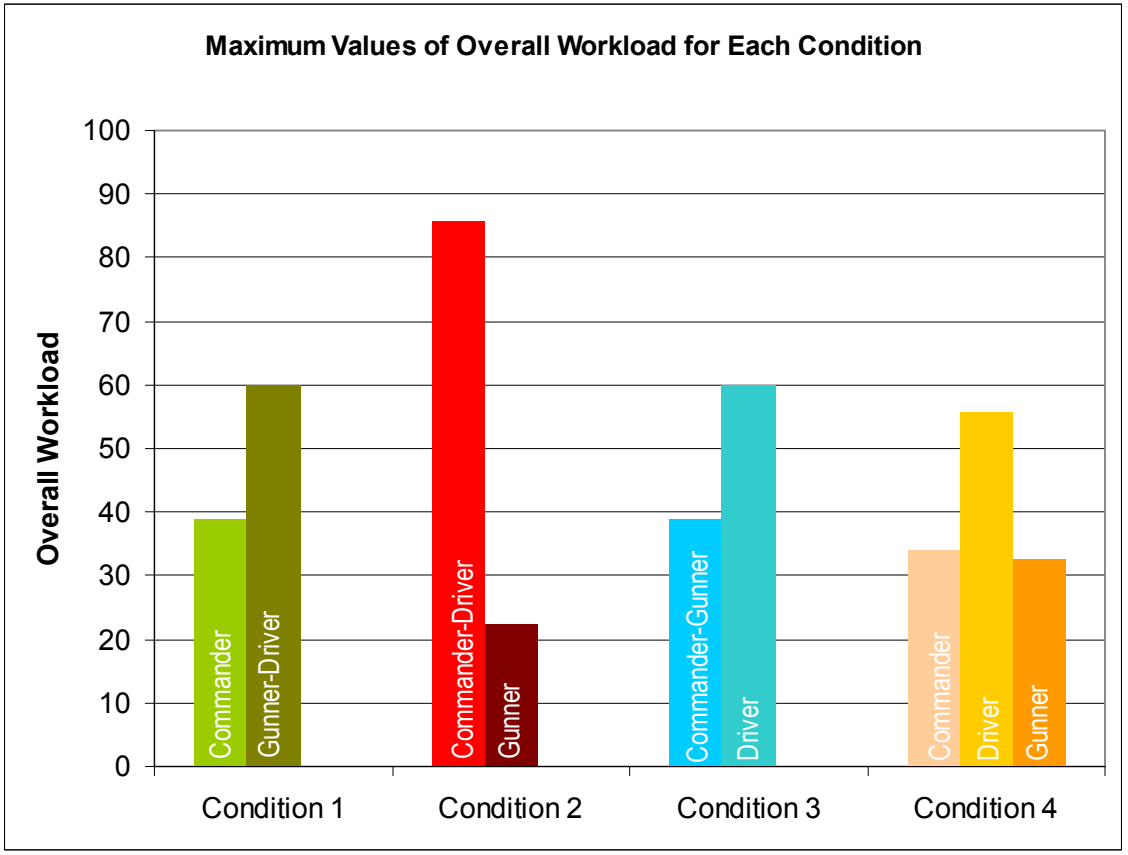
↓

Commander, Driver and Gunner

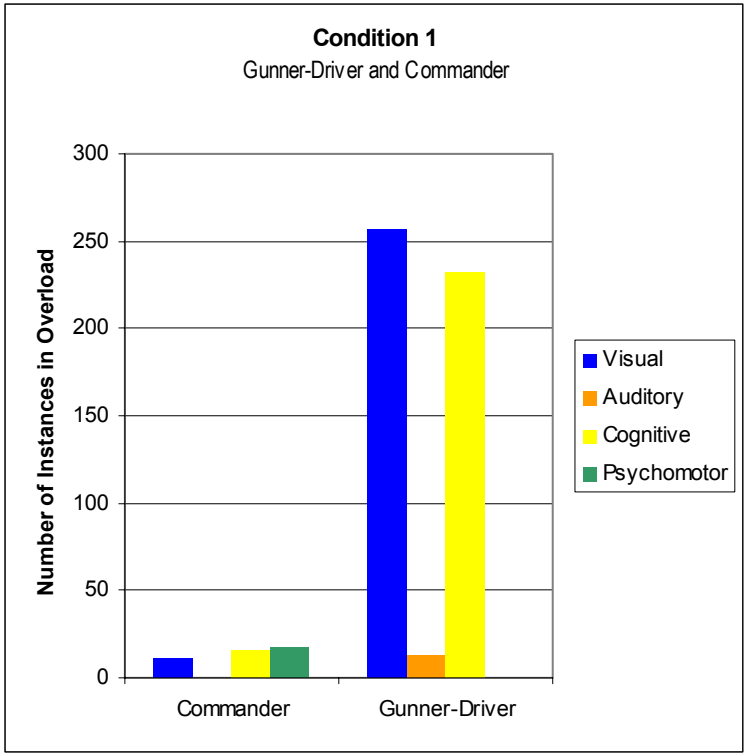
Two crewmembers scanning; allows hunter-killer philosophy

Data Tables

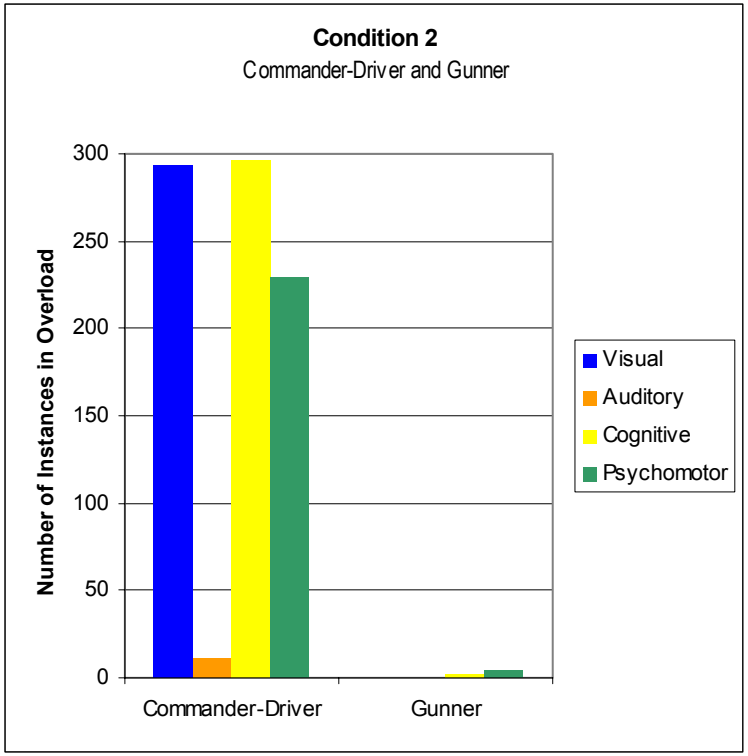
FCS Modeling Results



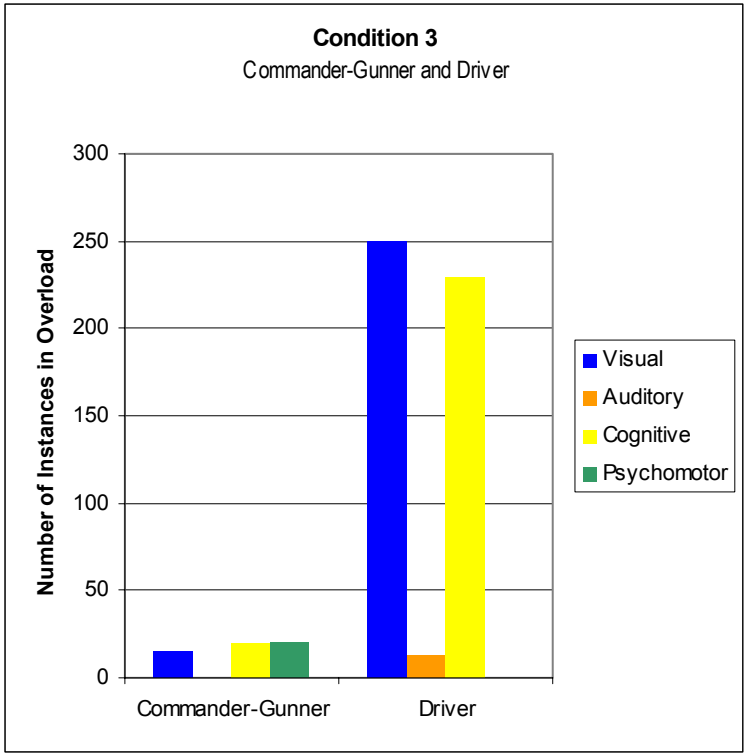
FCS Modeling Results



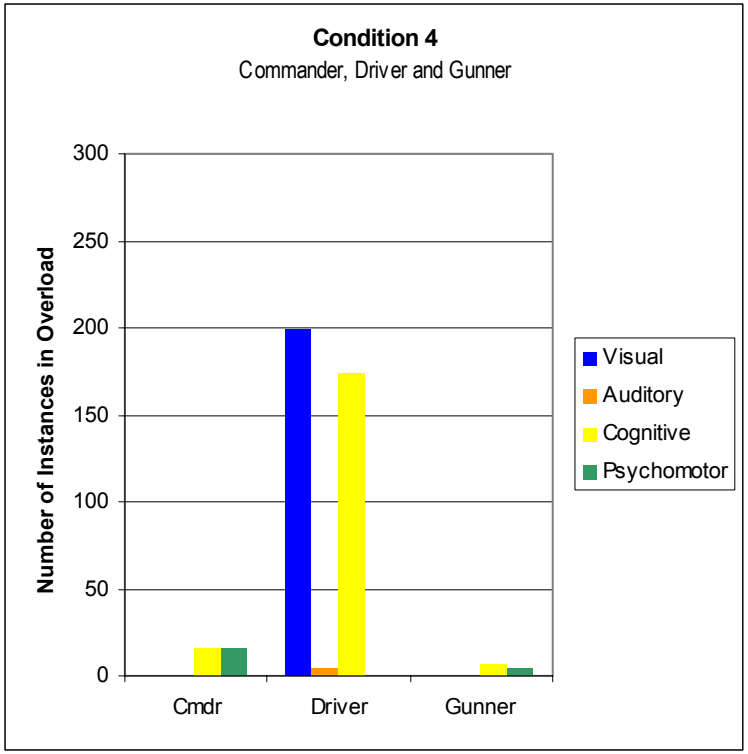
FCS Modeling Results



FCS Modeling Results



FCS Modeling Results



Commander-Driver and Gunner

Workload		Max Value		# times >7	
		Cmdr-Driver	Gunner	Cmdr-Driver	Gunner
	Visual	35	7	293	0
	Auditory	12	5	12	0
	Cognitive	31	9	296	2
	Psychomotor	14	9	229	5

Overall Workload		Cmdr-Driver	Gunner
	Max Value	86	23
	# times>40	225	0
	# times >60	61	0

Commander-Gunner and Driver

Workload		Max Value		# times >7	
		Driver	Cmdr-Gunner	Driver	Cmdr-Gunner
	Visual	24	13	250	15
	Auditory	16	1	13	0
	Cognitive	25	16	229	20
	Psychomotor	6	16	0	21

Overall Workload		Driver	Cmdr-Gunner
	Max Value	60	39
	# times>40	41	0

Commander, Driver and Gunner

Workload		Max Value			# times >7		
		Driver	Commander	Gunner	Driver	Commander	Gunner
	Visual	23	7	7	199	0	0
	Auditory	11	1	5	5	0	0
	Cognitive	24	17	14	173	16	7
	Psychomotor	6	15	9	0	16	5

Overall Workload		Driver	Commander	Gunner
	Max Value	56	34	33
	# times>40	28	0	0

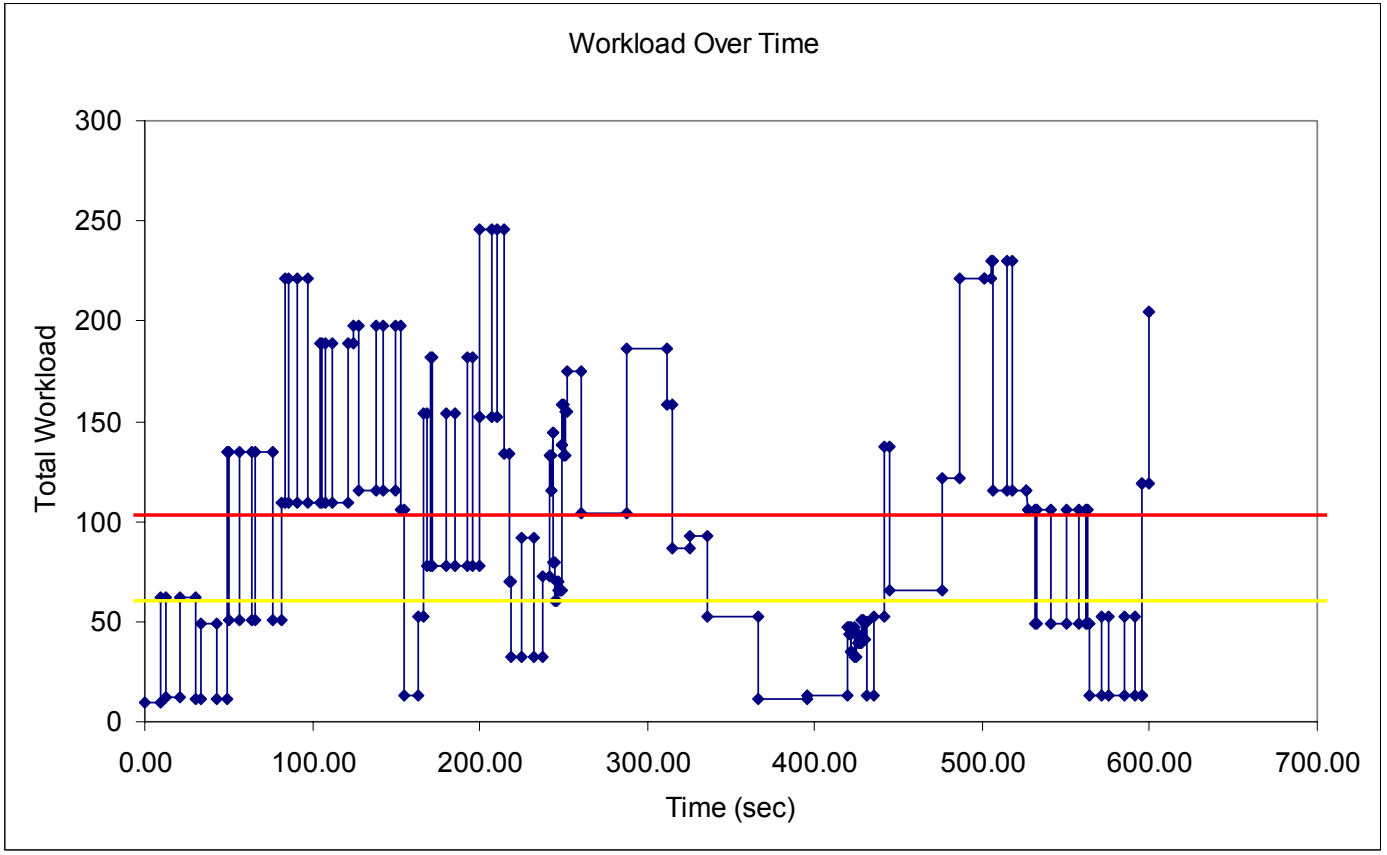
FCS Modeling Results

Gunner-Driver and Commander

Workload		Max Value		#times >7	
		Gunner-Driver	Commander	Gunner-Driver	Commander
	Visual	25	13	256	11
	Auditory	16	1	13	0
	Cognitive	25	16	232	16
	Psychomotor	6	16	0	17

Overall Workload		Gunner-Driver	Commander
	Max Value	60	39
	# times >40	42	0

FCS Modeling Results CG



Driving Model

Examining Semi-Autonomous Off Road Driving from a HIP Perspective

Experimental Design: 3x2x2 full factorial, "within subject"

Independent variables:

- Operator control (direct, teleoperated, semi-autonomous)
- Obstacle frequency (low, high)
- Vehicle reliability (low, high)

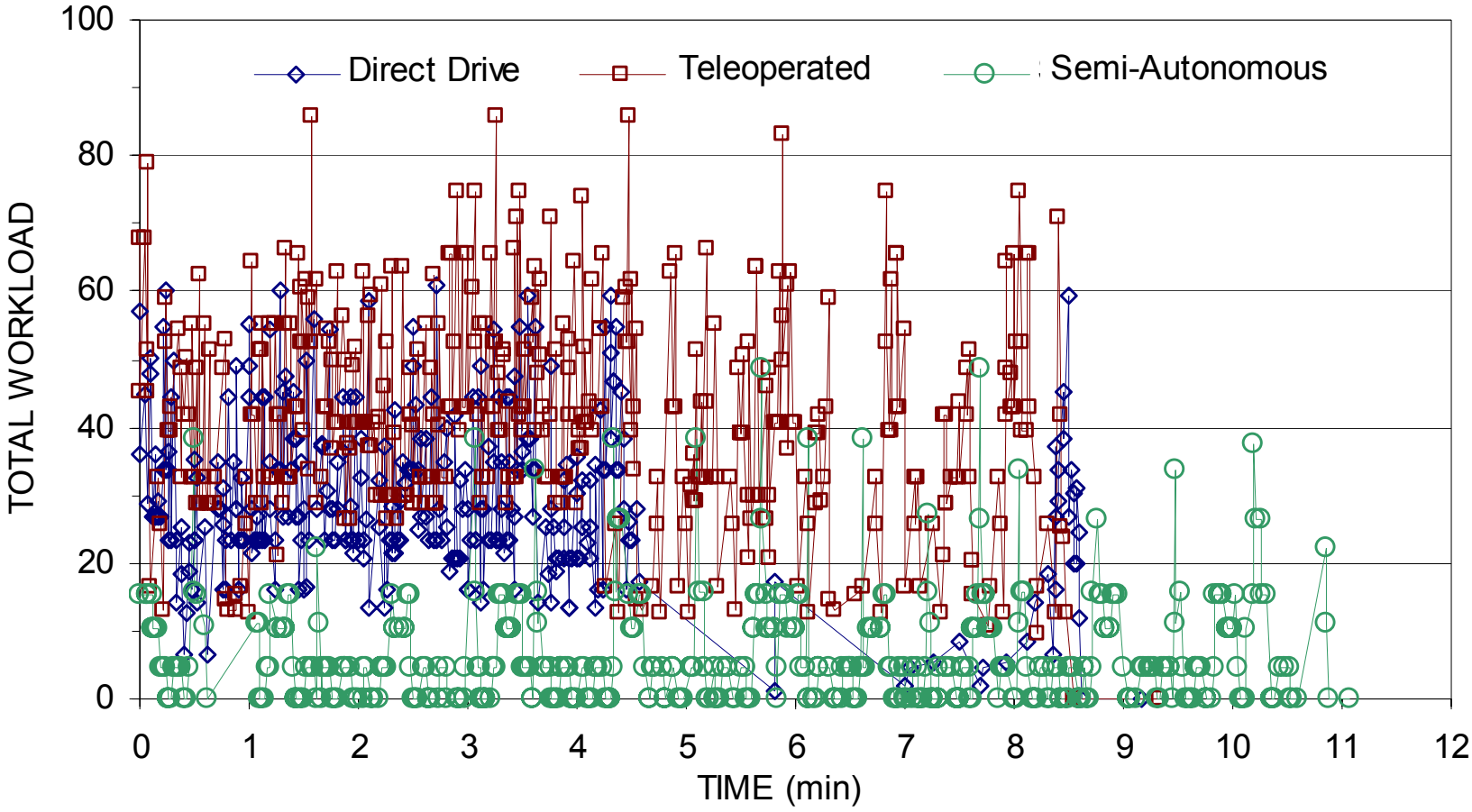
Dependent variables:

- Driver workload
- Mission completion time
- Mission completion rate

Sample size: determined with modeling approach

Examining Semi-Autonomous Off Road Driving from a HIP Perspective

Results: Workload; low obstacle; low reliability



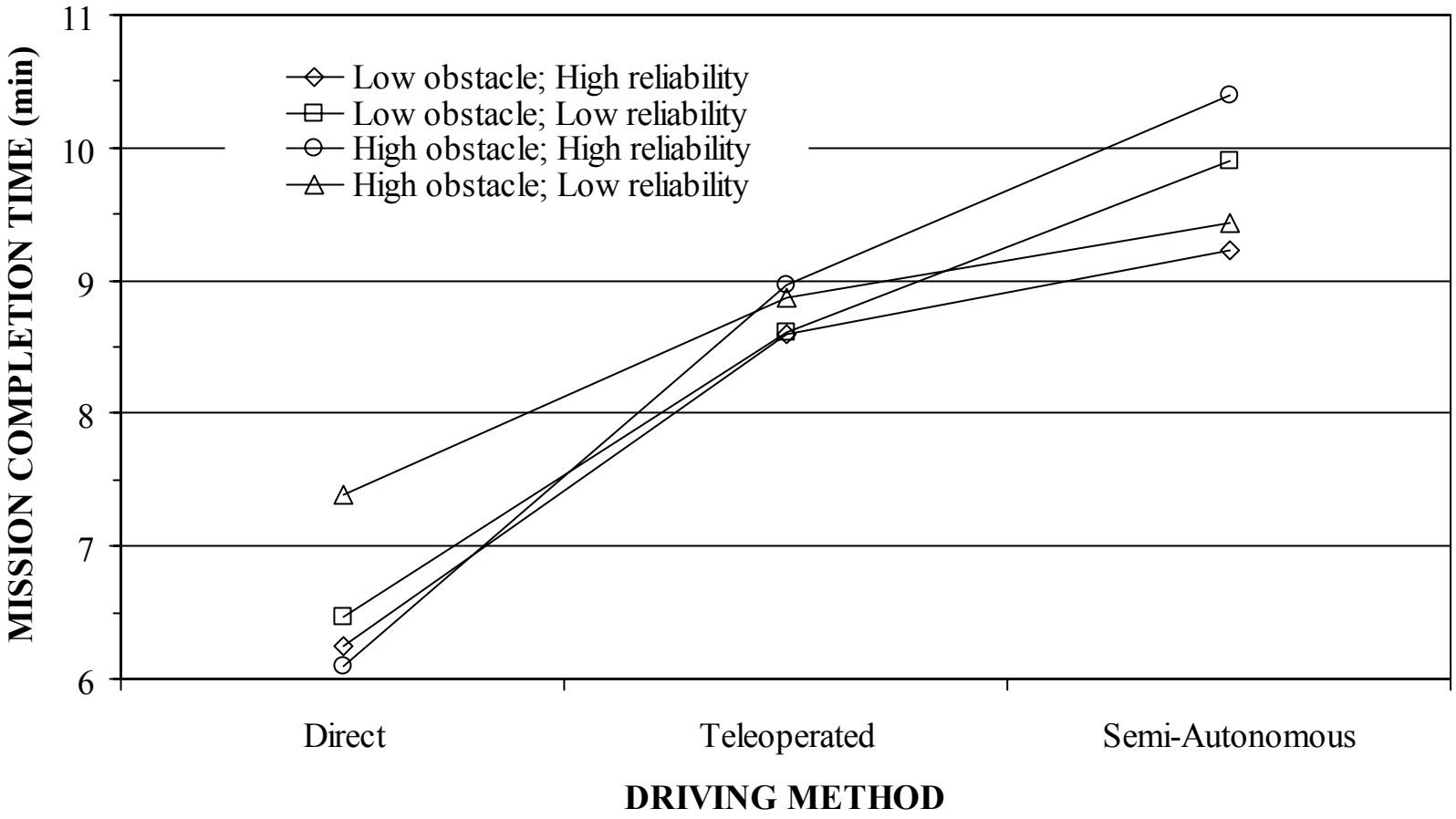
Examining Semi-Autonomous Off Road Driving from a HIP Perspective

Results: Direct driving workload spike

	Resources			
Concurrent Tasks	**Visual**	**Auditory**	**Cognitive**	**Psychomotor**
Talk	0.0	4.9	4.6	1.0
Coast	0.0	1.0	0.0	0.0
Don't steer	0.0	0.0	0.0	0.0
Recognize path	5.4	0.0	1.2	0.0
Determine dist. to objective	5.0	0.0	6.8	0.0
Assess orientation	5.0	0.0	1.0	0.0
Assess traction	0.0	4.3	1.0	0.0
Assess motion	3.7	1.0	4.6	0.0
Assess function	3.7	4.3	3.7	0.0
Resource Subtotal	22.8	15.5	22.9	1.0
Overall Resource Total	62.2			

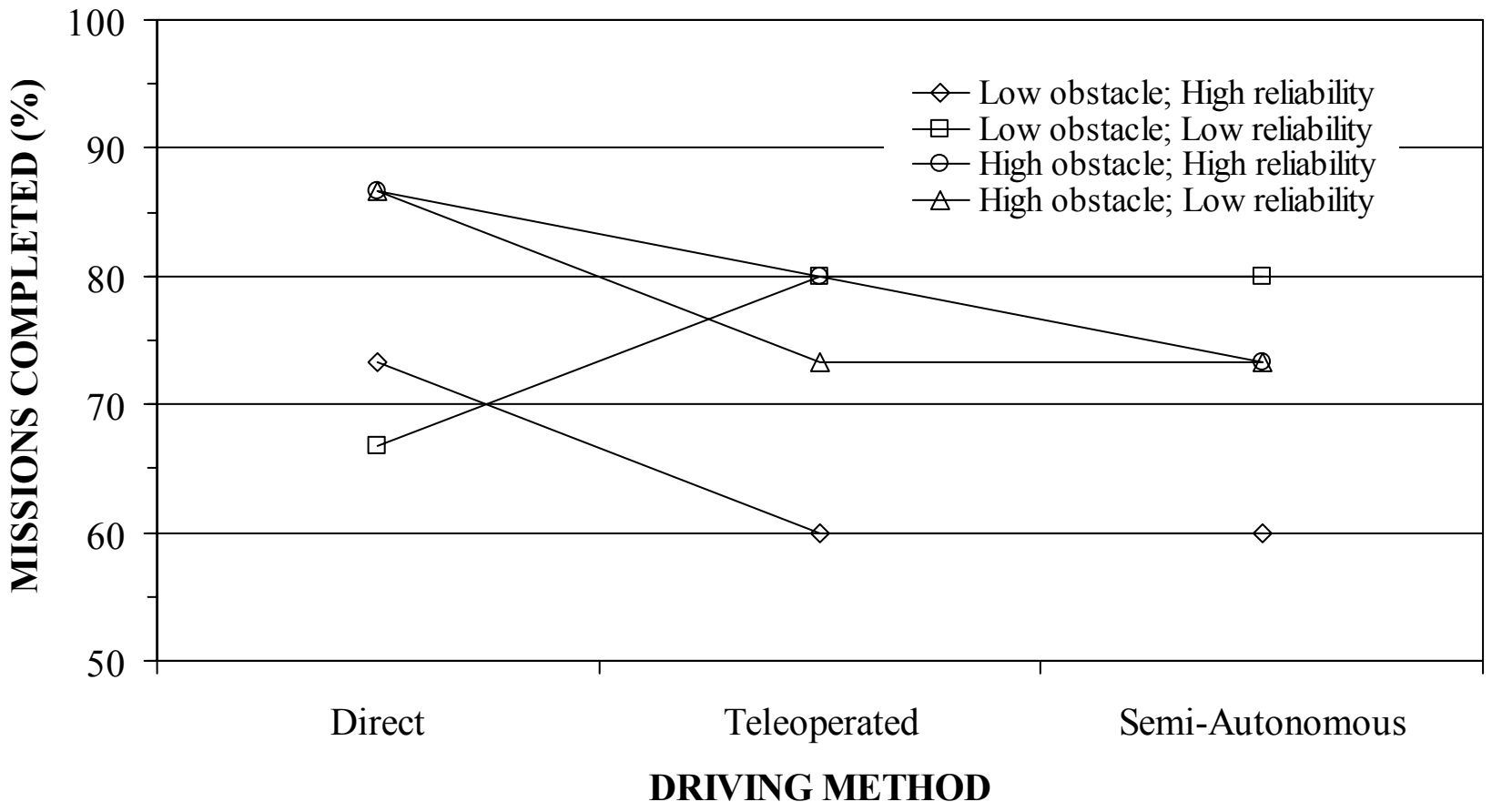
Examining Semi-Autonomous Off Road Driving from a HIP Perspective

Results: Mission completion time

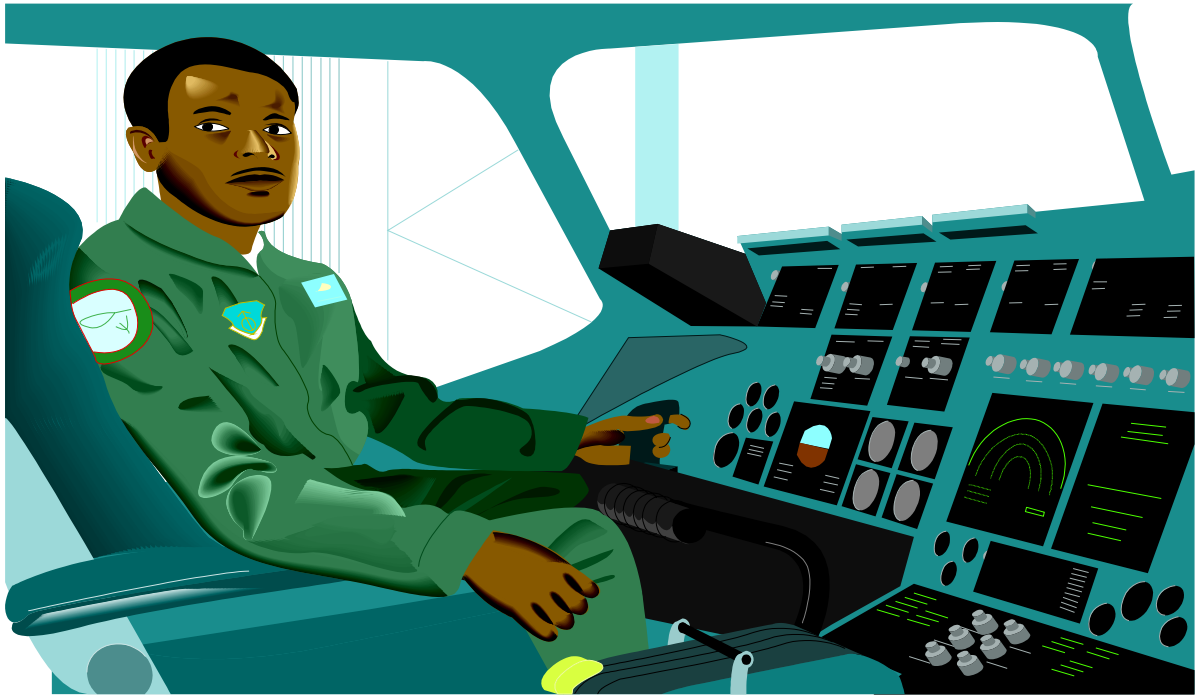


Examining Semi-Autonomous Off Road Driving from a HIP Perspective

Results: Mission completion rate



Define Soldiers



Define Soldiers Analyses

- *Stand Alone*
- Operators in *Define Mission*
- Maintainers in *Define Equipment*
- MOSs in *Define Force*

Personnel

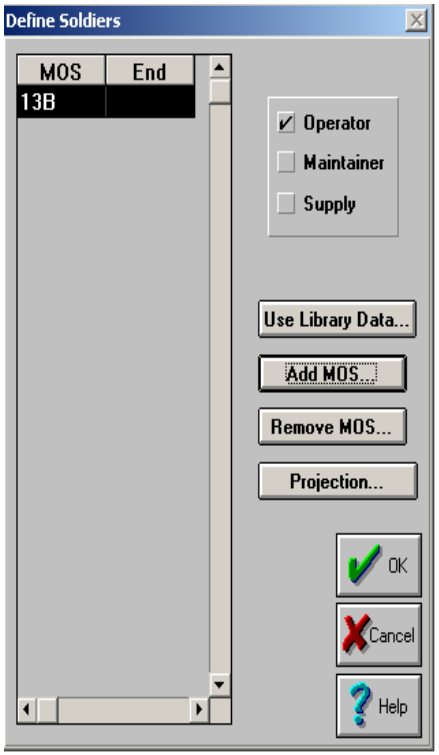
Characteristics

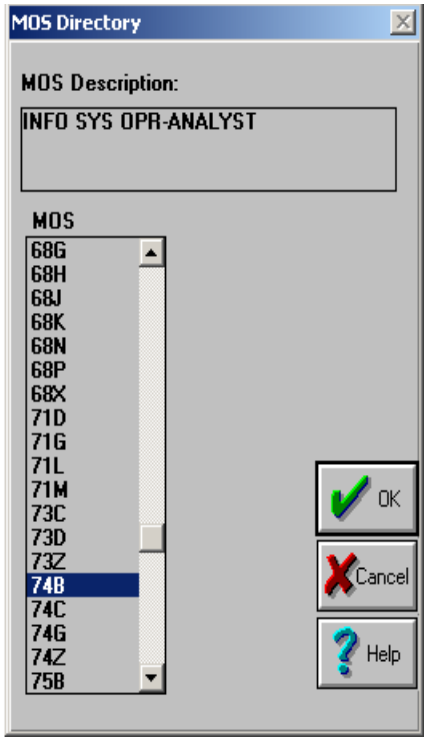
Define Soldiers

- Add or Delete MOSs
- Run Projection Model
  - Optional, but required to look at Personnel Reports
- Adjust Projection Model Parameters
  - Optional

Add or Delete MOSs

- Operator, Maintainer or Supply
- “Dummy” MOS’s (for Civilians or Contractors) & Officers





Performance Moderators

Predicting Human Performance

Define Mission

- Discrete event task networks
  - Performance measures
    - » Time
    - » Accuracy

Evaluate performance under different conditions

- Factors affecting human performance
  - Personnel characteristics
  - Sustainment training
  - Environmental stressors

Using Performance Moderators

- VACP or Goal Oriented missions only
- Apply stressors via
  - individual task
  - all tasks for an MOS or crew position
- Tasks must be described via "taxons"

Not all tasks are affected in the same way or by the same performance moderator

Taxons

"…categories used to describe the composition of a task."

1. Visual Recognition/Discrimination
2. Numerical Analysis
3. Information Processing/Problem Solving
4. Fine Motor Discrete
5. Fine Motor Continuous
6. Gross Motor Light
7. Gross Motor Heavy
8. Communication – Oral
9. Communication - Read & Write

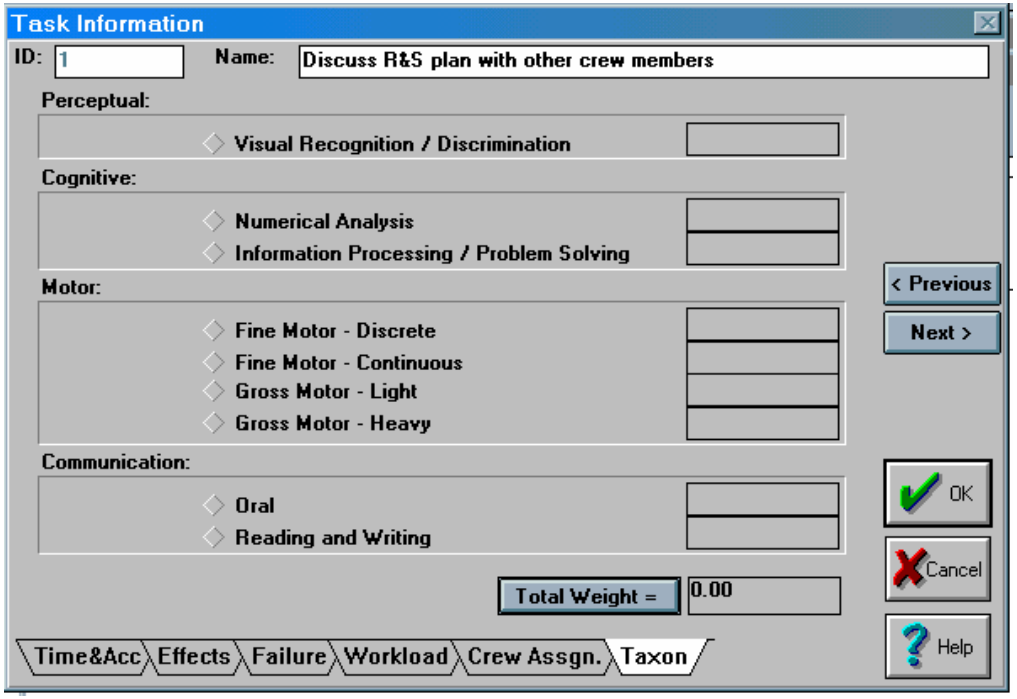
Taxon Examples

The Nine IMPRINT Taxons, Their Descriptions, and Task Examples
(Allender, Salvi et al., 1997)

Taxons	Definitions	Examples
Visual	Requires using the eyes to identify or separate targets or objects	• Seeing something move and then recognizing it as an enemy tank
Numerical	Requires processing arithmetical or mathematical calculations	• Measuring an azimuth on a map with a protractor • Estimating the distance between two points on a map
Cognitive (Problem Solving and Decision	Requires processing information mentally and reaching a conclusion	• Locating a fault in an electrical system after troubleshooting • Selecting the best firing position for a machine gun
Fine Motor Discrete	Requires performing a set of distinct actions in a predetermined sequence mainly involving movement	• Assembly and disassembly of the M-16 rifle • Starting the engine of a truck
Fine Motor Continuous	Requires expending extensive physical effort or exertion to perform an action	• Driving a vehicle • Tracking a moving target
Gross Motor Heavy	Requires expending extensive physical effort or exertion to perform an action	• Lifting an artillery round • Loosening a very tight bolt with a wrench
Gross Motor Light	Requires moving the entire body (i.e., not just the hands) to perform an action without expending	• Getting into a prone firing position • Evacuating a tank
Communication (Read and Write)	Requires either reading text or numbers that are written somewhere or writing text or numbers that can	• Reading a preventive maintenance checklist for a vehicle • Writing a letter home
Communication (Oral)	Requires either talking or listening to another person	• Giving a situation report by radio • Receiving a password from someone while on guard duty

Assigning Taxons

Taxons are used to calculate impact of performance moderators



Rules

- Weightings must equal 1.0
- No more than 3 taxons per task

Two methods

- User defines for each task
- Convert VACP workload ratings into taxon assignment

Performance Shaping Functions

- Used Project A database - ARI
  - 1985 data
  - 9,500 soldiers total
  - 9 different military occupational specialties
  - full data set on 9-MOS sample = 5,000 soldiers
  - updated in 1997 with longitudinal data

11B - Infantryman
13B - Cannon Crewman
19E - Tank Crewman
31C - Radio Teletype Op
63B - Veh & Gen. Mech Spc.
71L - Admin Spec
91A - Med Care Spec
88M - Motor Transport Operator
95B - Military Police

- Derived algorithms describing relationship of MOS personnel characteristics and training frequency & recency with task performance by task type

- Provided "what if" options in IMPRINT

Personnel Characteristics

ASVAB* Composite

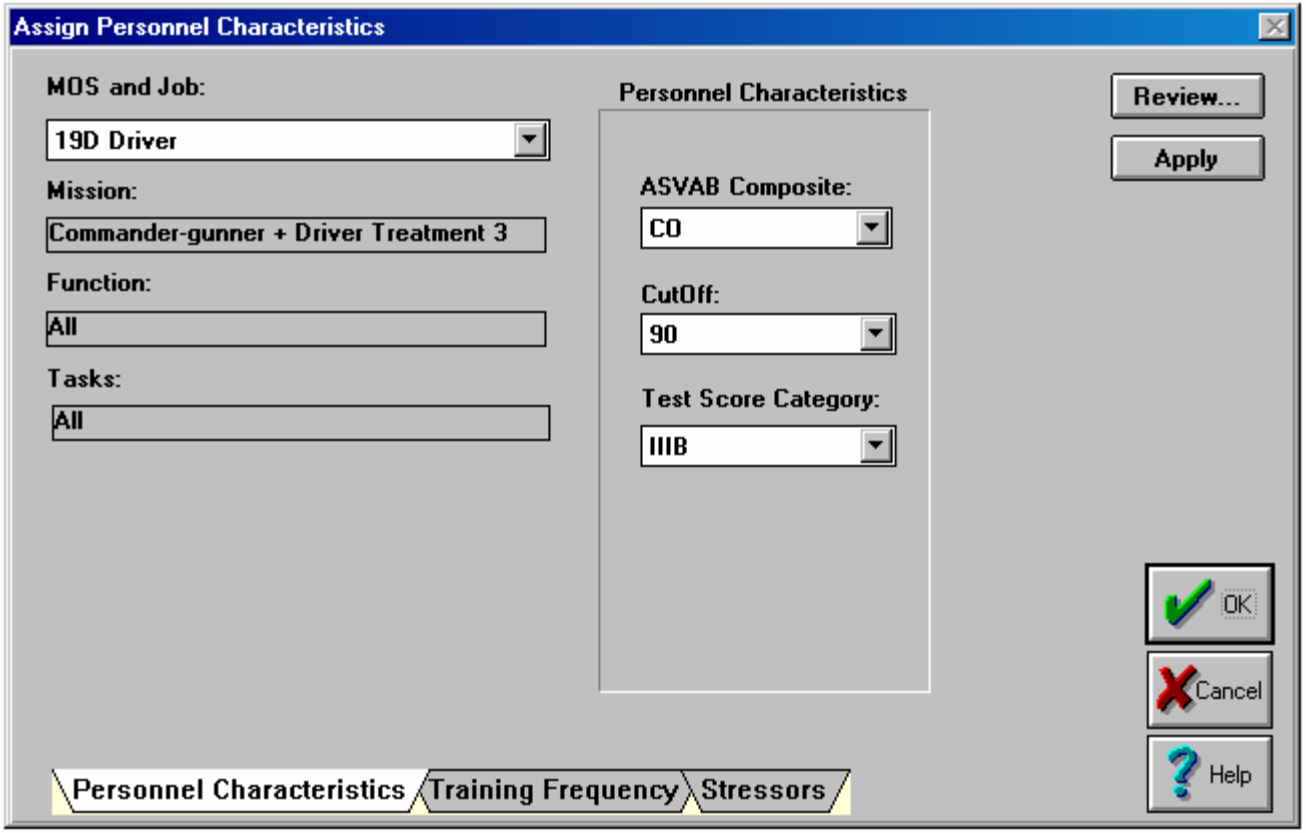
CL-ST

Test Score Category Cutoff

0 - 135

Test Score Category

II - IV



*Armed Services Vocational Aptitude Battery

Impact of Personnel Characteristics

(currently modeled in IMPRINT)

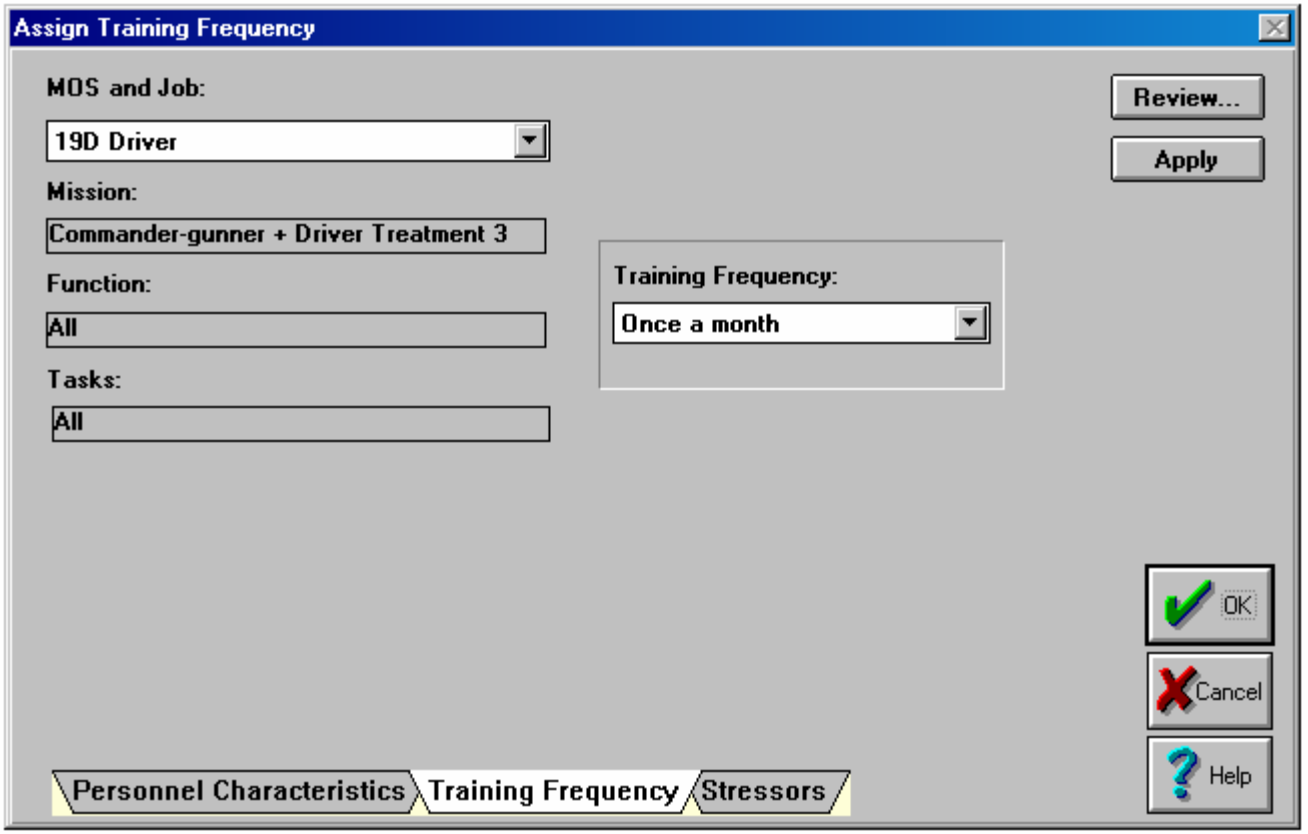
Taxons	Increase/decrease of ASVAB affects:
Visual	A
Numerical Analysis	T/A
Information Processing	T/A
Fine Motor - Discrete	T/A
Fine Motor - Continuous	
Gross Motor - Light	A
Gross Motor - Heavy	
Commo (Reading & Writing)	T/A
Commo (Oral)	A

T = affects task time, A = affects task accuracy, TA= affects both

Sustainment Training

Training Frequency

Less than twice a year – once a week or more



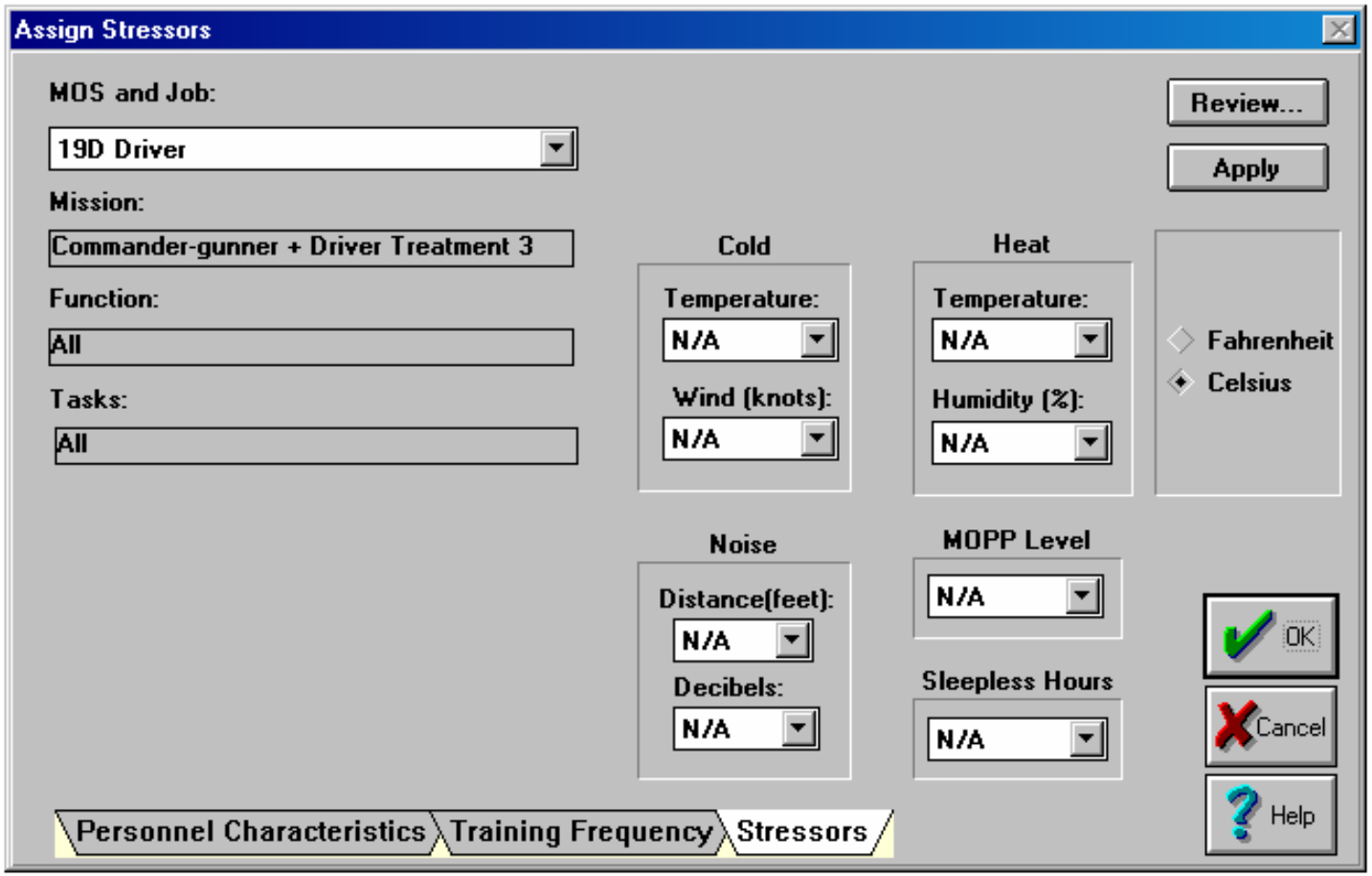
Impact of Training

(currently modeled in IMPRINT)

Taxons	Less than twice a year	Less than once a month	Once a month (default)	2 or 3 times a month	Once or more a week
Visual					
Numerical Analysis	T/A	T/A	T/A	T/A	T/A
Information Processing					
Fine Motor - Discrete	A	A	A	A	A
Fine Motor - Continuous					
Gross Motor - Light					
Gross Motor - Heavy					
Commo (Reading & Writing)	T/A	T/A	T/A	T/A	T/A
Commo (Oral)					

T = affects task time, A = affects task accuracy, TA= affects both

Environmental Stressors Screen



Environmental Stressors

Heat	measured by	**Temperature & Humidity**
Cold	measured by	**Temperature & Wind speed**
Noise	measured by	**Distance & Noise level (dbs)**
MOPP	measured by	**Level (0 - 4)**
Sleepless Hours	measured by	**Hours since last slept**

When stressors are applied to tasks,
either accuracy, time, both or neither are affected

Impact of Stressors

(currently modeled in IMPRINT)

Taxon	MOPP	Heat	Cold	Noise	Sleepless Hours
Visual	T	A	T		
Numerical		A			TA
Cognitive		A			TA
Fine Motor Discrete	T	A	T		
Fine Motor Continuous					
Gross Motor Light	T		T		
Gross Motor Heavy					
Commo. (Read & Write)		A			
Commo. (Oral)	T	A		A	

T = affects task time, A = affects task accuracy, TA= affects both

Not all tasks are affected in the same way or by the same stressor

Impact of Stressors

IMPRINT Environmental Stressors and the Taxon Types Affected by Either Time or Accuracy or Both (adapted from **Micro Analysis & Design** and **Allender, Salvi et al., 1997)**

Taxons	MOPP	Heat	Cold	Noise	Sleepless Hours
Visual	T	A	T	NO DATA	**A**
Numerical	NO DATA	A	**NO EFFECT**	NO DATA	TA
Cognitive (Problem Solving and Decision Making)	NO DATA	A	**NO EFFECT**	NO DATA	TA
Fine Motor Discrete	T	A	T	NO DATA	NO DATA
Fine Motor Continuous	NO DATA	NO DATA	NO DATA	NO DATA	**T**
Gross Motor Light	T	NO DATA	**T - CONFLICT**	NO DATA	**NO EFFECT**
Gross Motor Heavy	NO DATA	NO DATA	NO DATA	NO DATA	**NO EFFECT**
Communication (Read and Write)	NO DATA	A	NO DATA	NO DATA	NO DATA
Communication (Oral)	T	A	NO DATA	A	NO DATA

T = Affects task time A = Affects task accuracy TA = Affects both NO DATA = No research identified for input T – CONFLICT = current data shows a conflict with current IMPRINT degradation and the literature Items in bold are new stressor degradations not currently in IMPRINT

Stressor Update in Process...

- Hours since last sleep
  - IMPRINT too optimistic! Impact at < 24 hours
  - Does affect all taxons
- Circadian rhythm
  - Important stressor including interaction w/ sleep loss
  - Need time of day interface
- Nuclear, biological, & chemical
  - Exposure effects, type & time; need to map to IMPRINT taxons
- Vibration
  - Dimensions of vibration
- Noise
  - Does affect cognitive tasks
- Some empty cells in IMPRINT matrix are OK

Combining Stressors

Power Function

$$DF_T = \prod_{i=1,n} \sqrt[i]{DF_i}$$

Where:

DF_T = Total degradation factor

DF_i = The i^{th} degradation factor when when ordered from largest effect to smallest effect

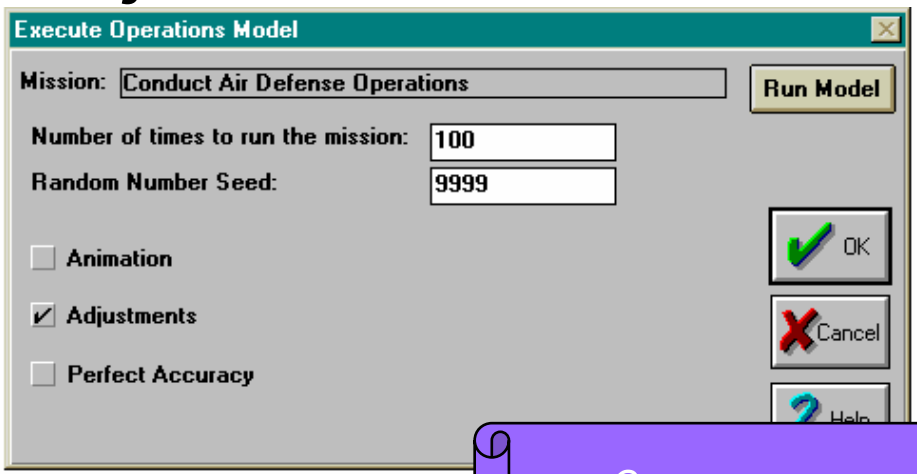
n = Number of degradation factors

Applying All PTS Options

- First apply ***Personnel Characteristics***
- Then apply ***Training Frequency***
- Apply ***Stressors*** last

Running the Model with PTS Options

- Run baseline model first
- Apply PT and/or S
- Review effects by task
- Re-run model with Adjustments selected
- Compare outputs with baseline



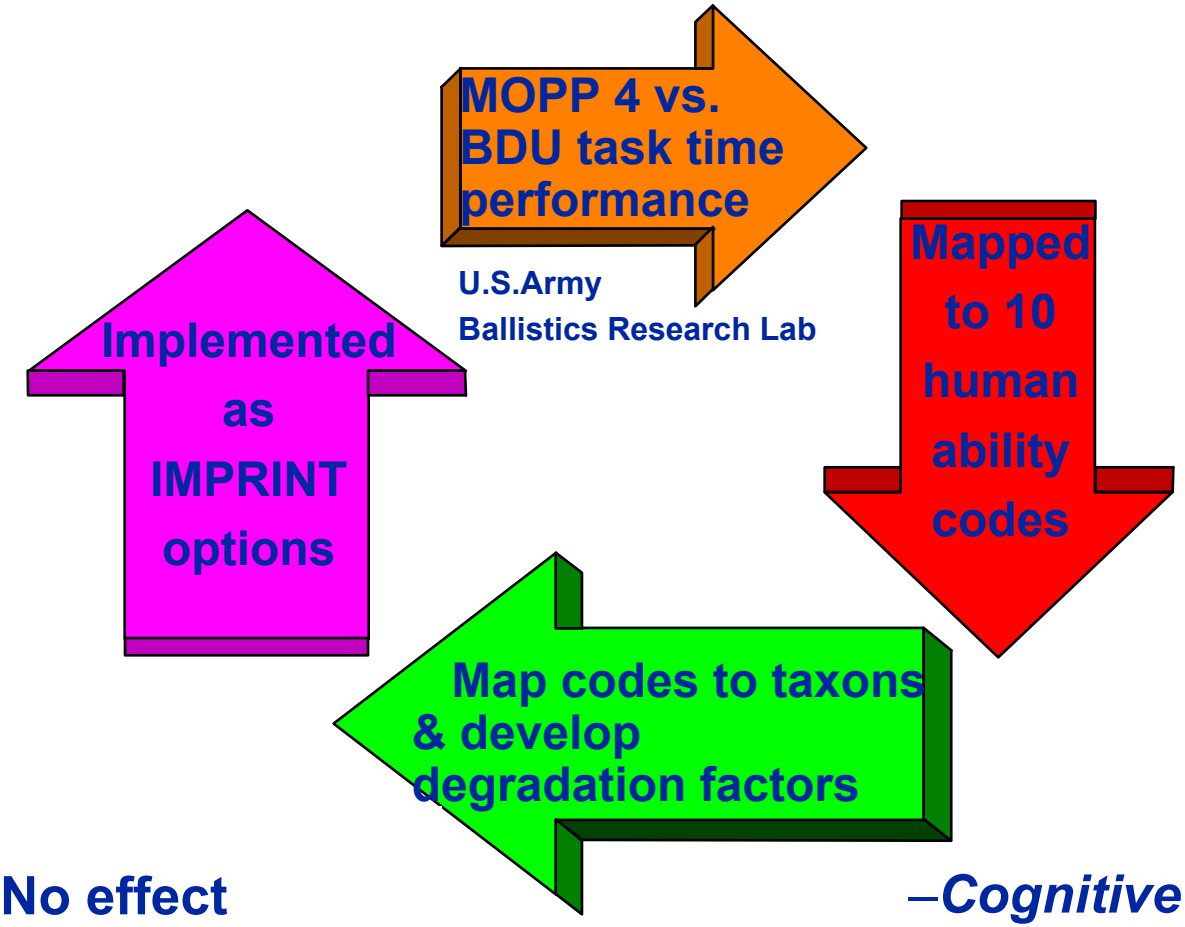
Practical Exercise

Workload to Taxons

Mental Workload Ratings	Taxons
Visual 1.0, 3.7, 4.0, 5.0, 5.4, 7.0	Visual
Cognitive 7.0	Numerical Analysis
Cognitive 1.0, 1.2, 3.7, 4.6, 5.3, 6.8	Information Processing
Psychomotor 2.2, 4.6, 5.8, 7.0	Fine Motor - Discrete
Psychomotor 2.6	Fine Motor - Continuous
---	Gross Motor - Light
---	Gross Motor - Heavy
Auditory 4.9, 6.6, 7.0 *Psychomotor* 1.0	Commo (Reading & Writing)
Visual 5.9 *Psychomotor* 6.5	Commo (Oral)
Auditory 1.0, 2.0, 4.2, 4.3	---

Note: VACP workload scores do not map to Gross Motor taxons because workload channels are mental not physical workload

Development of MOPP Degradation Factors



MOPP 0 = No effect

...

–MOPP 4 = Up to 1.7 X as long

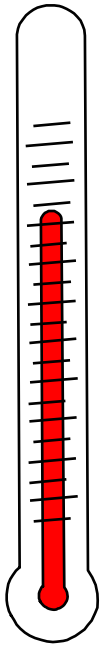
–Cognitive degradation?

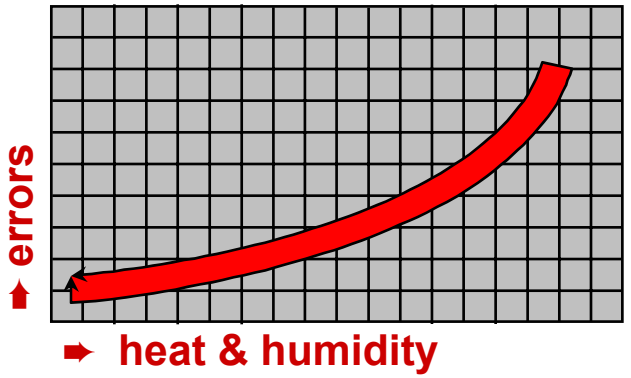
–Accuracy degradation?

–Work rate parameter?

Development of Heat Degradation Factors

- Heat degradation factors in IMPRINT derived from studies relating heat stress to inaccurate performance
  - » Bioastronautics Data Book, 1981
  - » Parker, 1973
  - » MIL-HDBK-759A

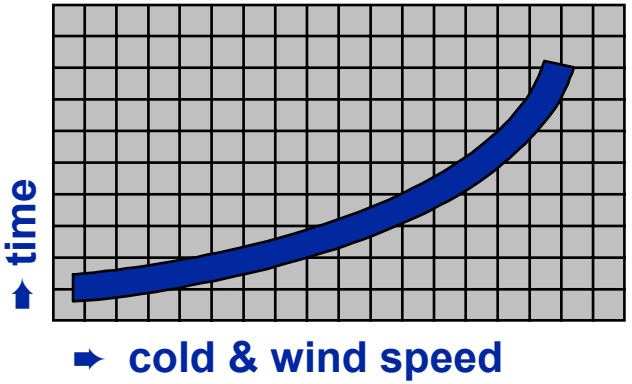




  - *Additional parameters (work rate, clothing, etc.)?*

Development of Cold Degradation Factors

- Cold degrades task time as a function of ambient temperature and wind velocity
  - Derived from Teichner (1958) relating wind chill to % performance loss
    - » One for visual reaction time & fine motor discrete
    - » Another for gross motor light



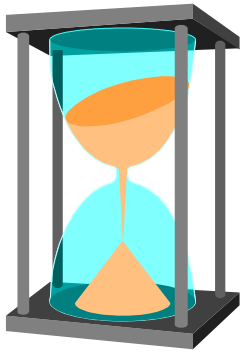
  - Assumes bare skin
  - Assumes linear degradation across decreasing temperatures

Development of Noise Degradation Factors

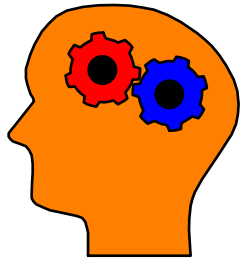
- Noise degrades task accuracy as a function of noise level & speaker-listener distance
  - Derived from Human Engineering Design Criteria MIL-STD-1472C

  - Need to consider communication frequency & voice level

Development of Sleepless Hours Degradation Factors



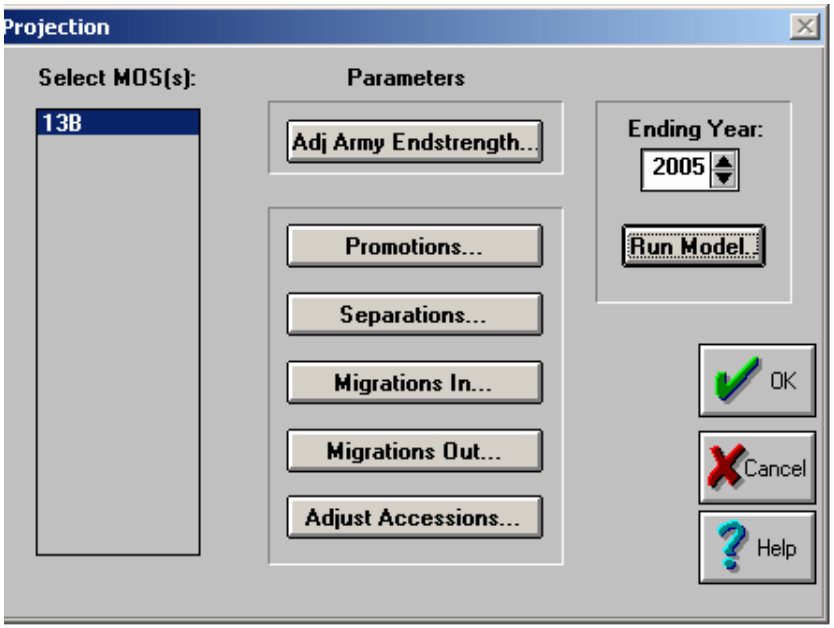
- Hours since last sleep degrades time & accuracy
  - Derived from a review of several studies
  - Cognitive performance is more sensitive to degradation than physical strength and endurance tasks
  - Decline in performance is roughly 25% for every 24 hours of operation
  - *Need degradation for non-cognitive work*



Projection Model

Projection Model Data

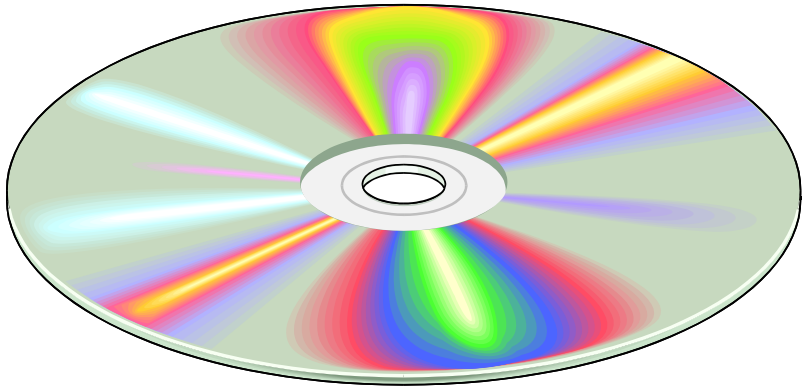
- Current inventory
- Promotion rates
- Separation rates
- Migration in & out rates
- Historical accessions



Use Army Library Data

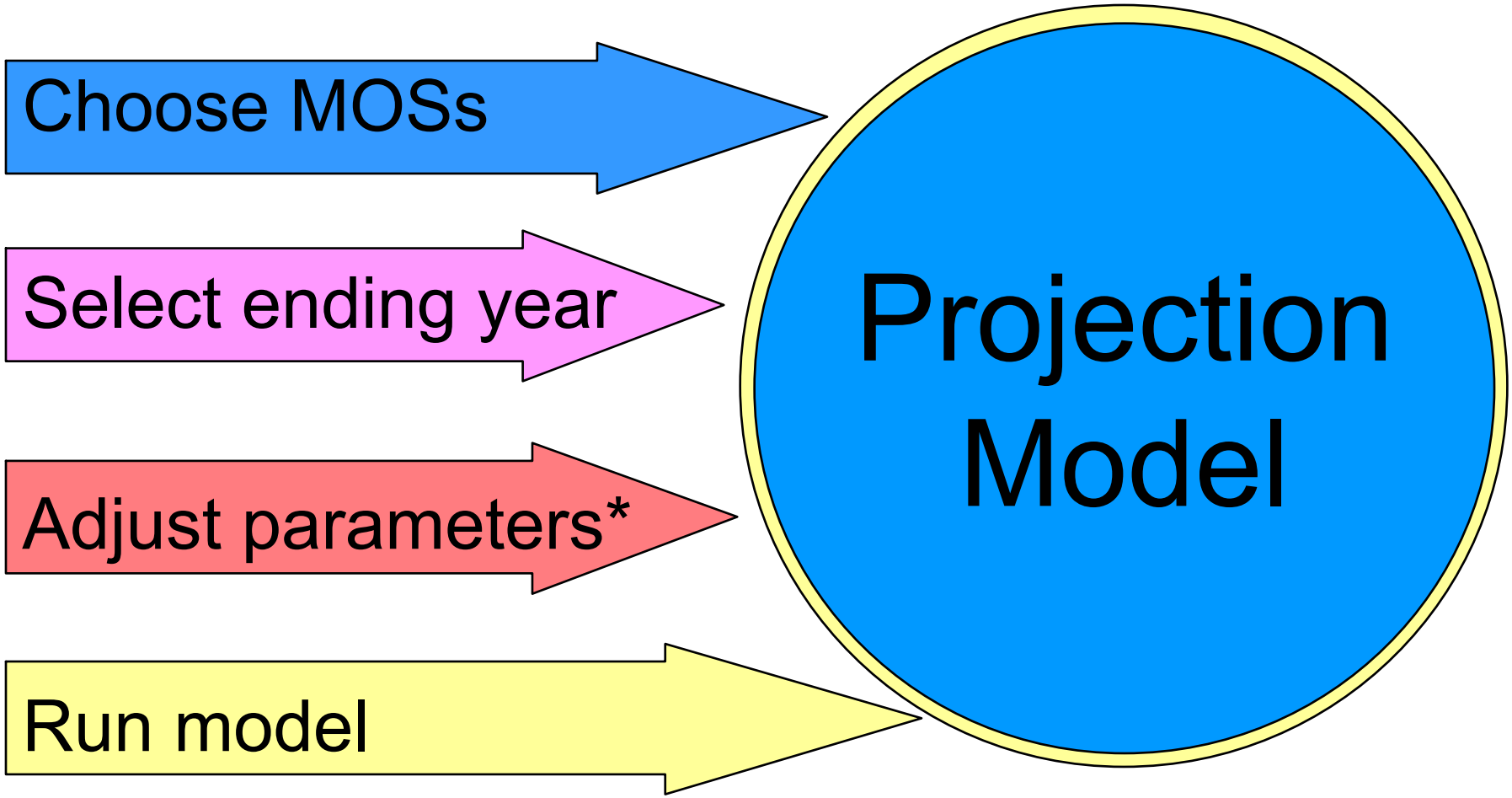
- MOS data for 22 historical systems
- Operators and maintainers
- Associated personnel characteristic data

MARC Maint. Database



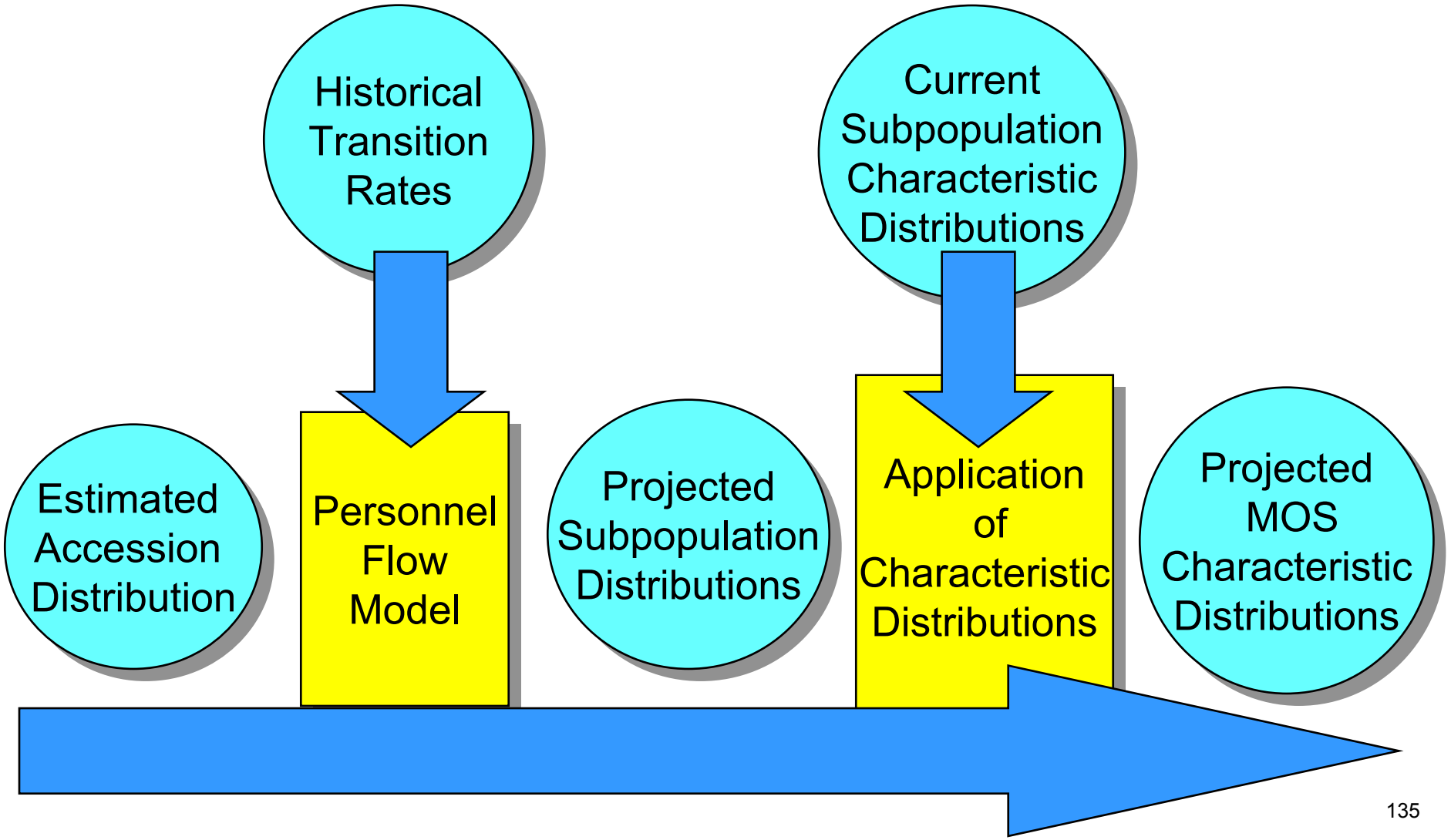
Enlisted Master File

Run Projection Model



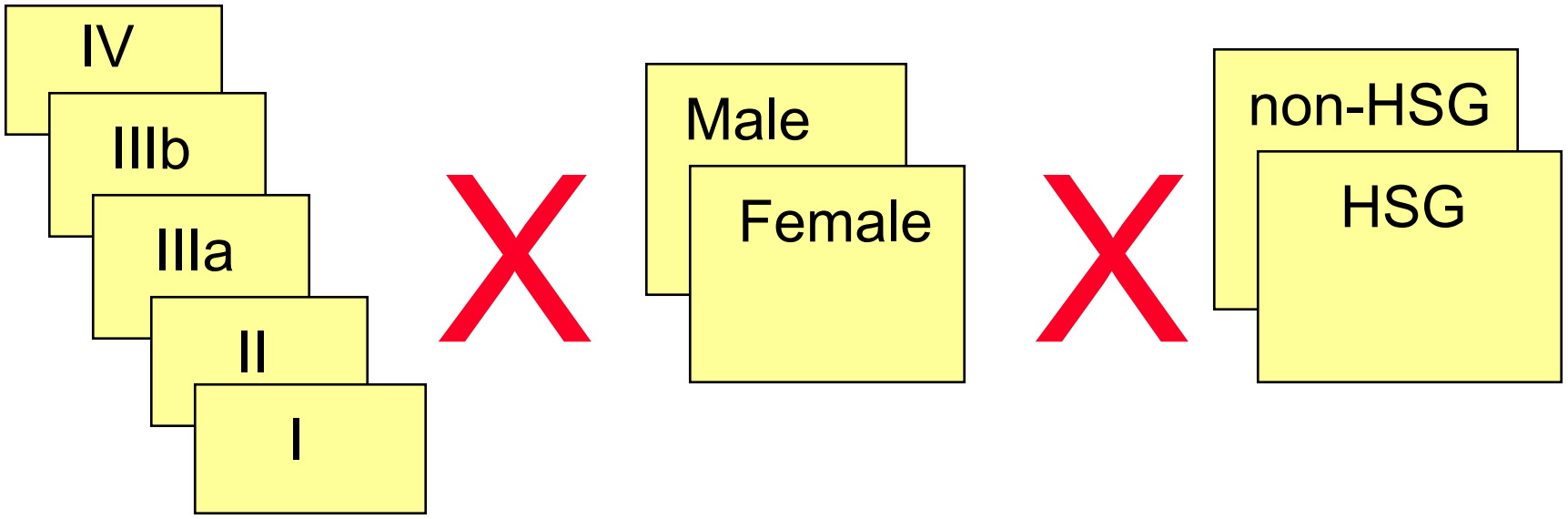
* optional step

Projection Model



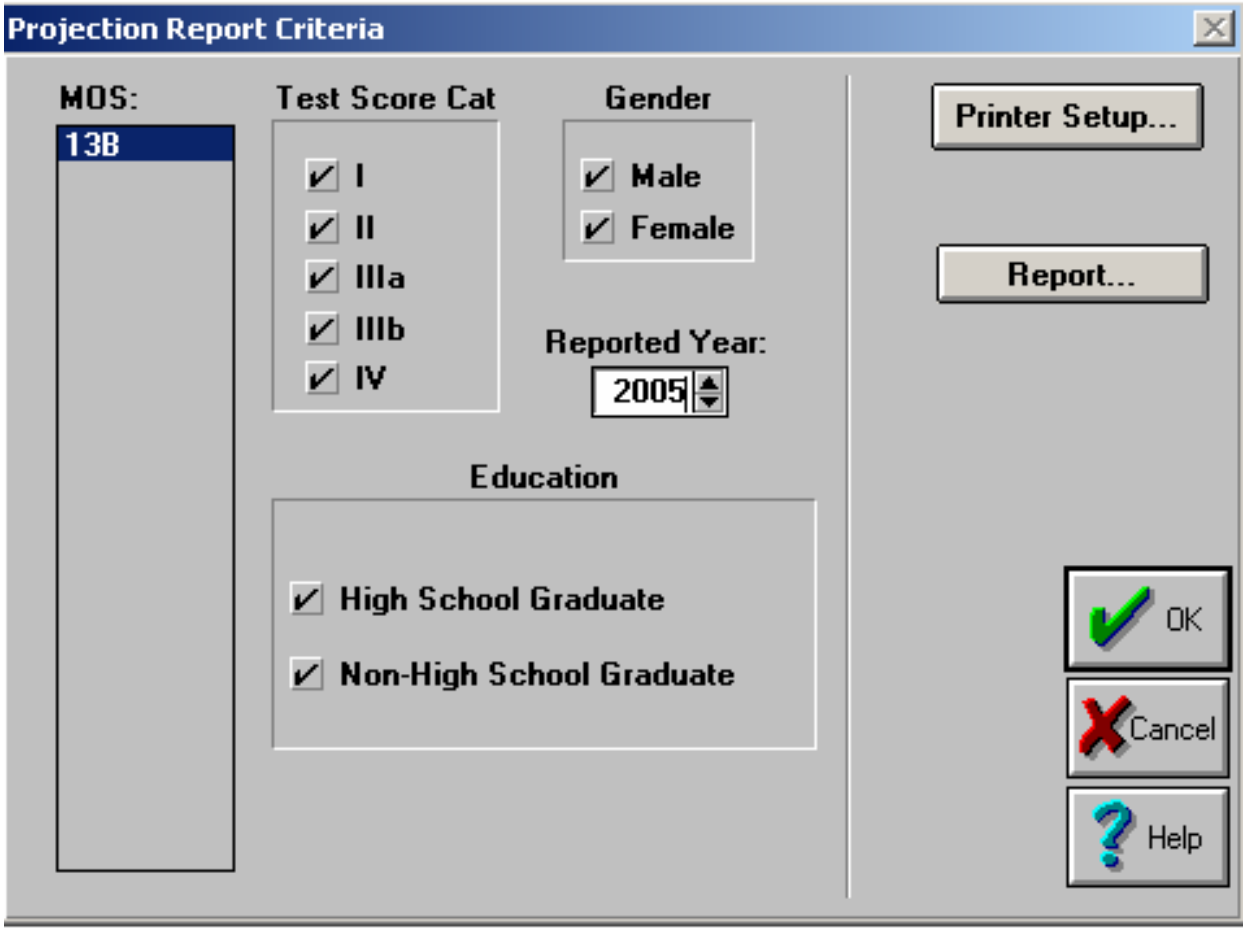
Subpopulations

By MOS and Grade

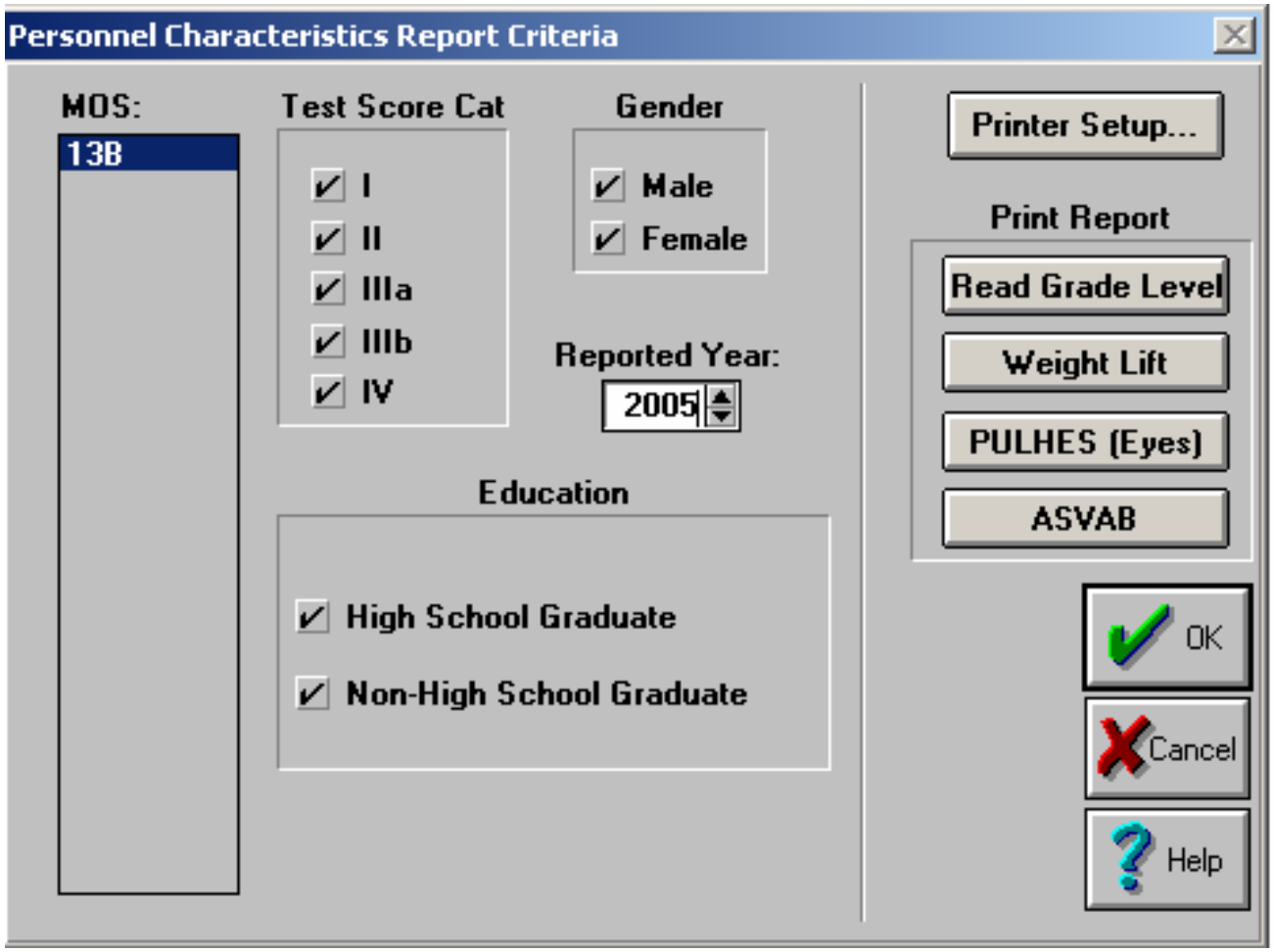


Each subpopulation is flowed separately

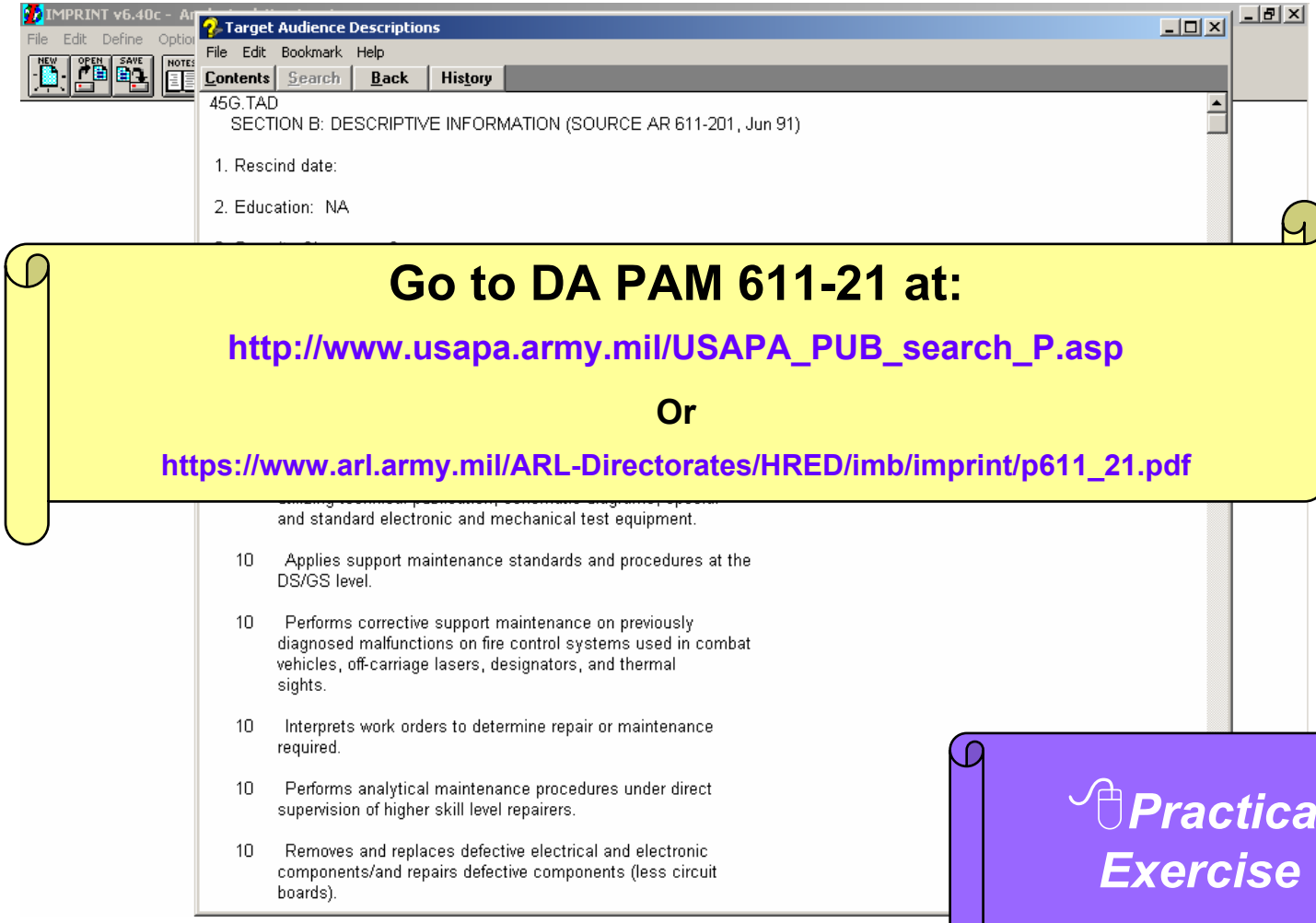
Define Soldiers Reports



Define Soldiers Reports (cont)



Target Audience Description Info



Go to DA PAM 611-21 at:

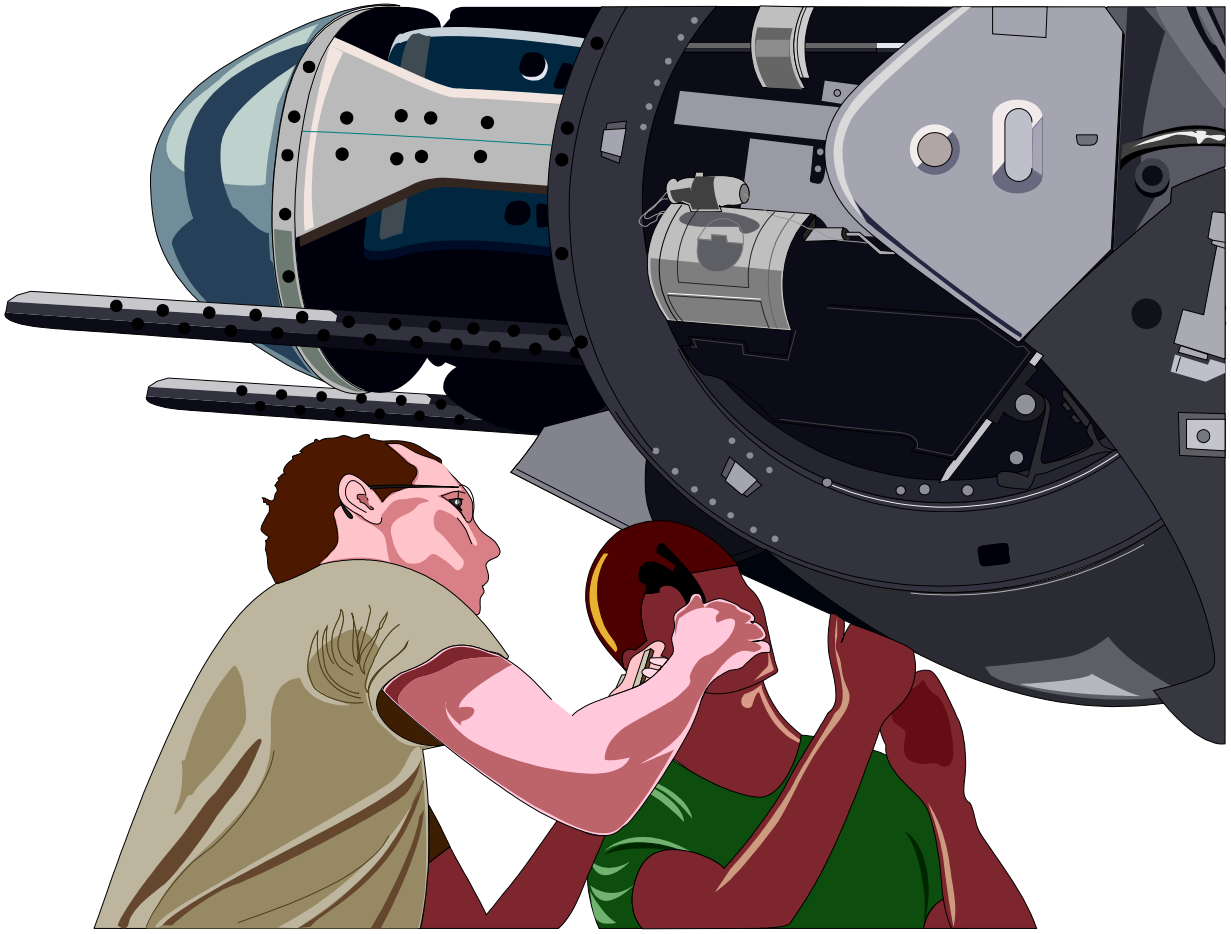
http://www.usapa.army.mil/USAPA_PUB_search_P.asp

Or

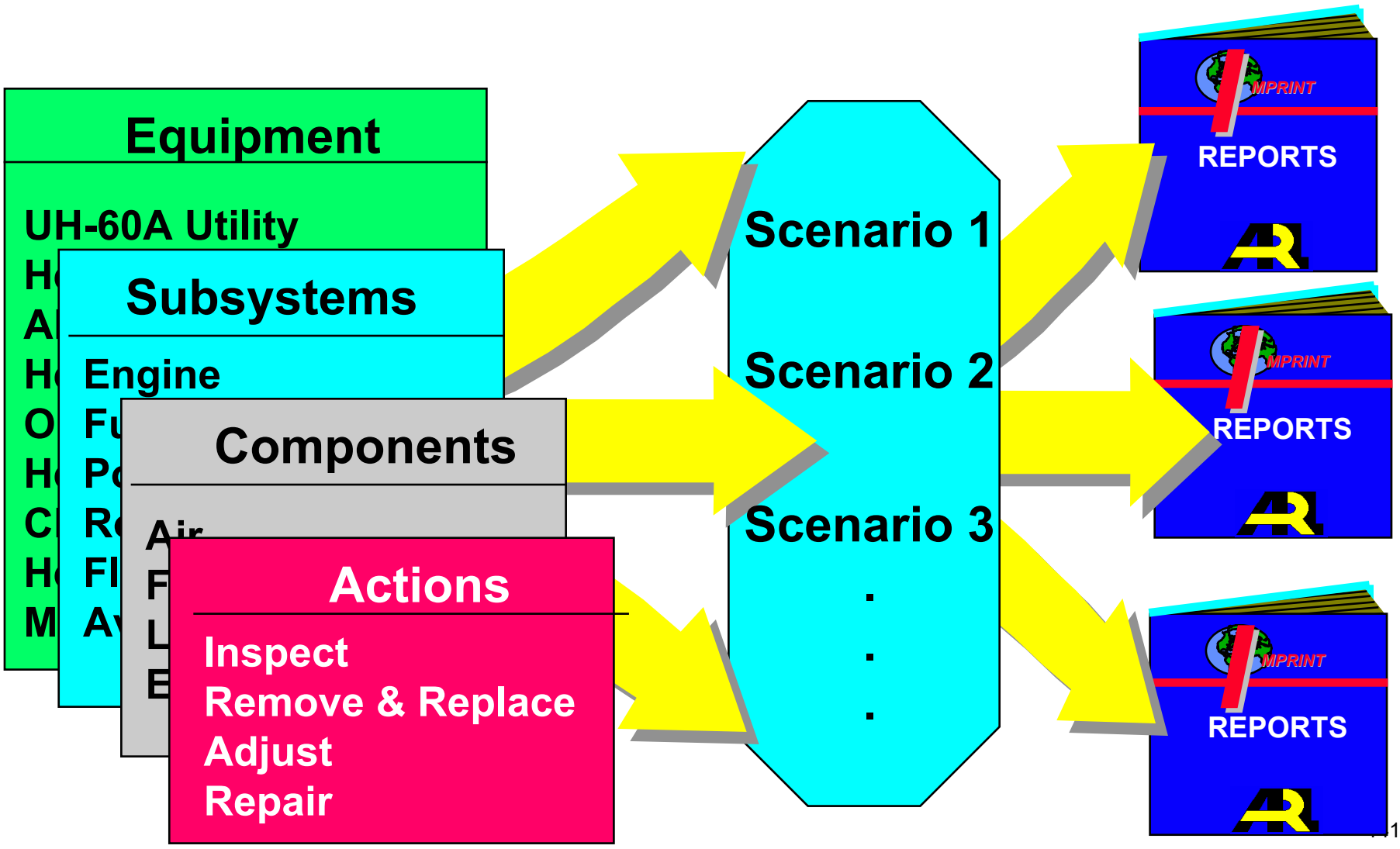
https://www.arl.army.mil/ARL-Directorates/HRED/imb/imprint/p611_21.pdf

Practical Exercise

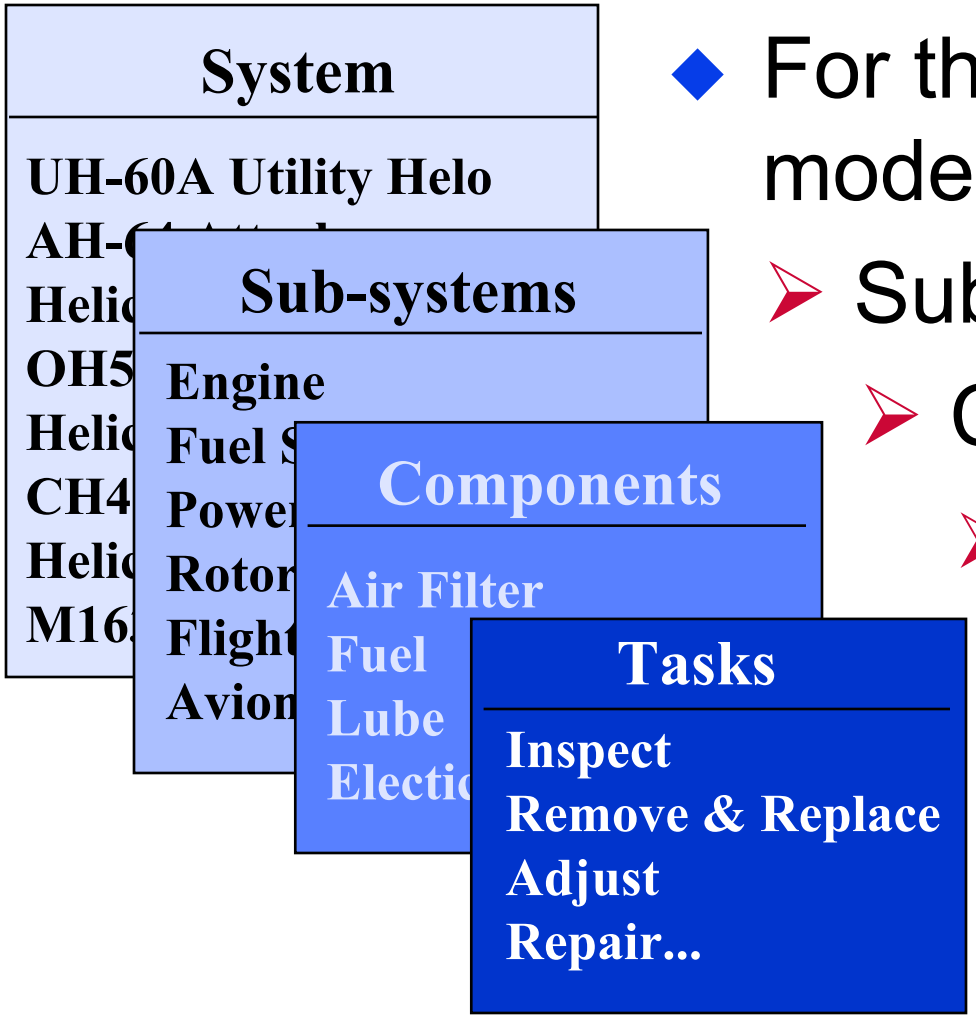
Define Equipment



Define Equipment Process



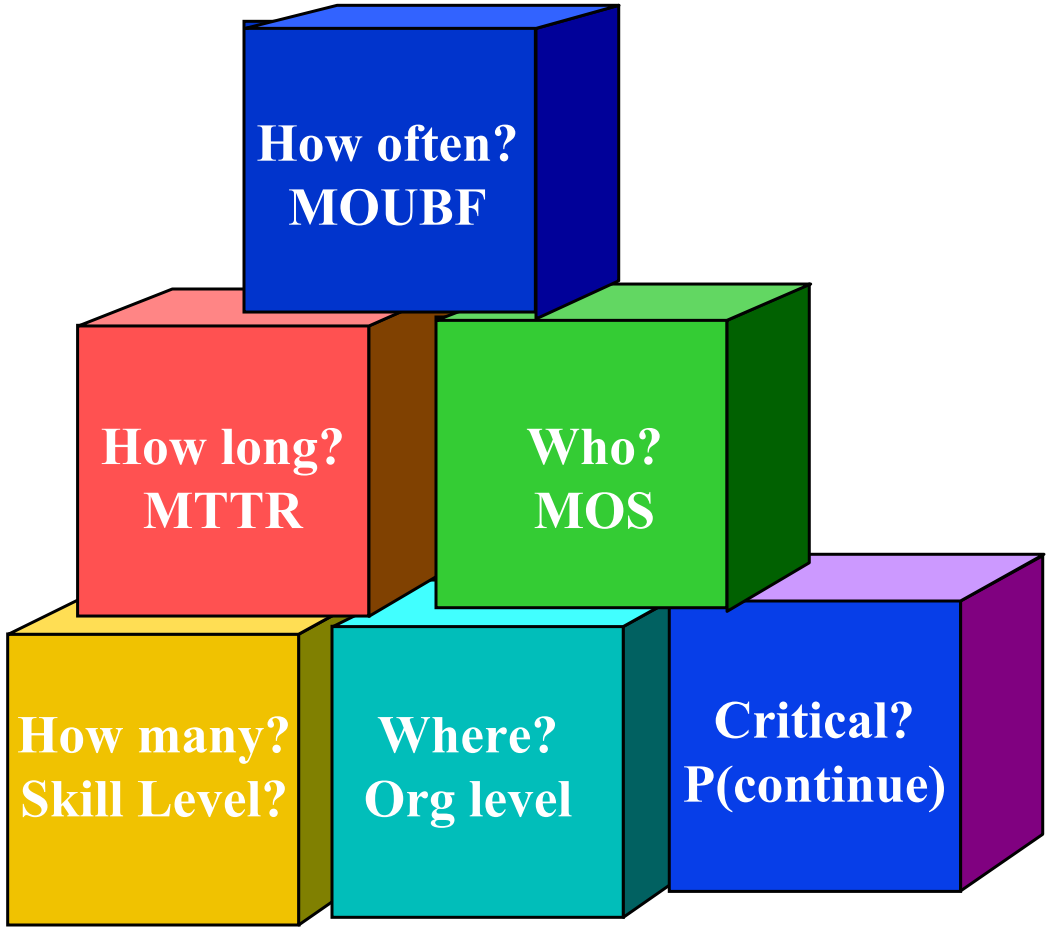
System-to-Task Decomposition



- For the system being modeled, identify
  - Sub-systems
    - Components
      - Tasks which are either corrective or preventive

Maintenance Task Data

- Mean operational unit between failure (i.e., maintenance actions
- Mean time to repair
- Soldier job specialty
- How many of what skill level
- Organizational level
- Mission criticality

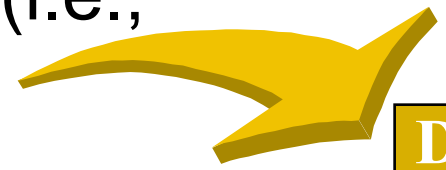


Scenario Elements

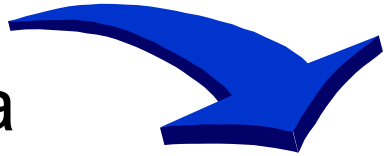
- System Operational Profile
- Maintenance Crew
  - Number & types of people available to do the maintenance on each shift
- Travel Time
  - Amount of time to get system to the people (or people to the system) on the battlefield
- Repair Parts
  - Likelihood a part is available
  - Average wait time, if not available

Operational Profile Data Items for Every Segment

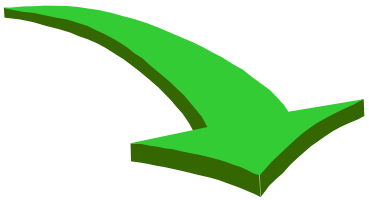
- Consumables (i.e., Usage) data
- Time & systems data
- Combat data



Distance traveled
Rounds fired
Load Time

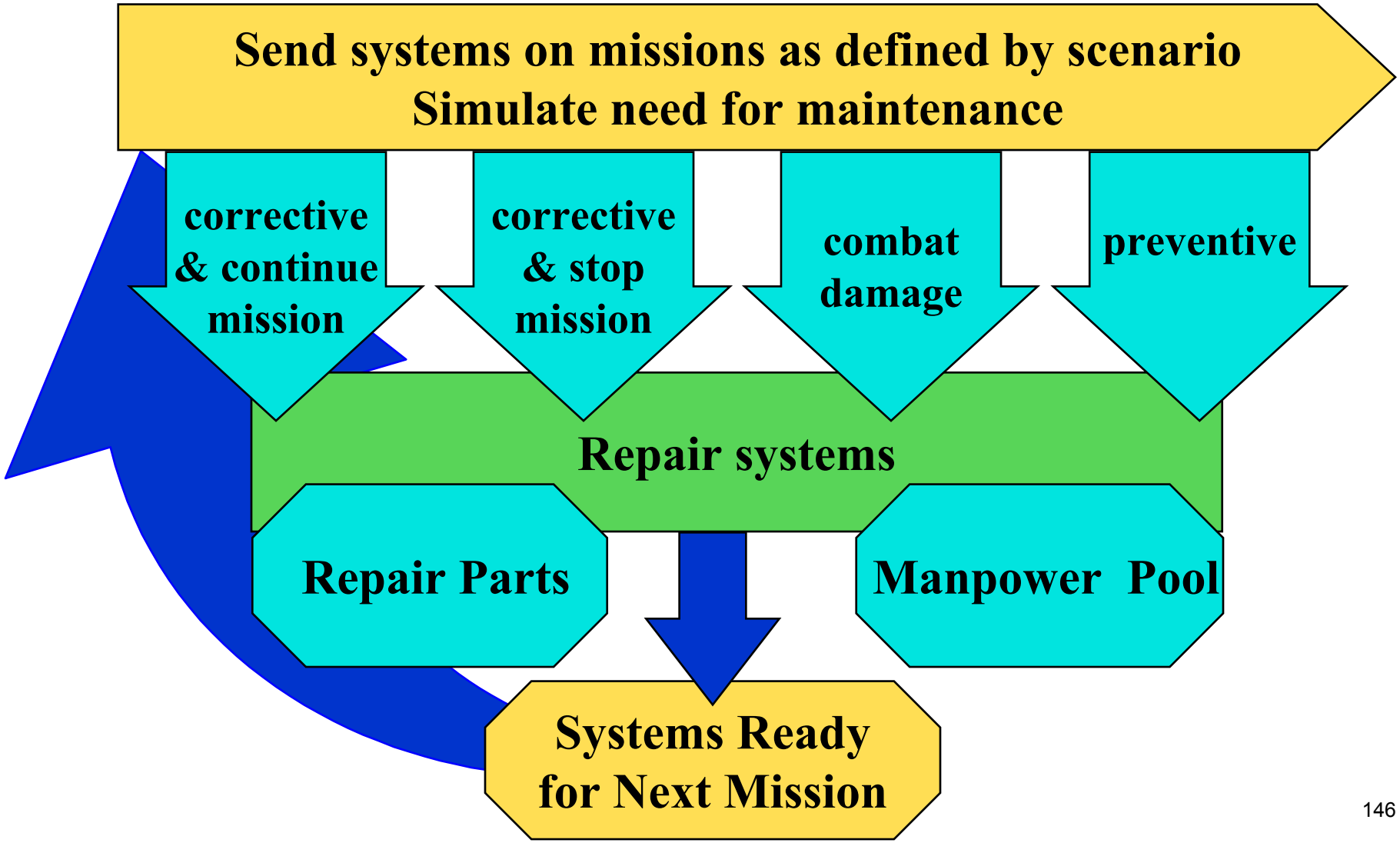


Start time & day
Duration
Priority
Max and min # systems needed
Number of systems per mission



Probability of hit
Probability of kill
Replacement time

Stochastic Maintenance Model



Maintenance Model Reports

Detailed & Summary Measures

- Maintenance manhours by:
  - task, component, & sub-system
  - preventive & corrective maintenance
  - organizational level
  - soldier job specialty

- Achieved operational availability & readiness
- Maintenance to operational hours ratio
- High driver subsystems
- Personnel utilization
- Logistics downtime
- Combat damage
- ...

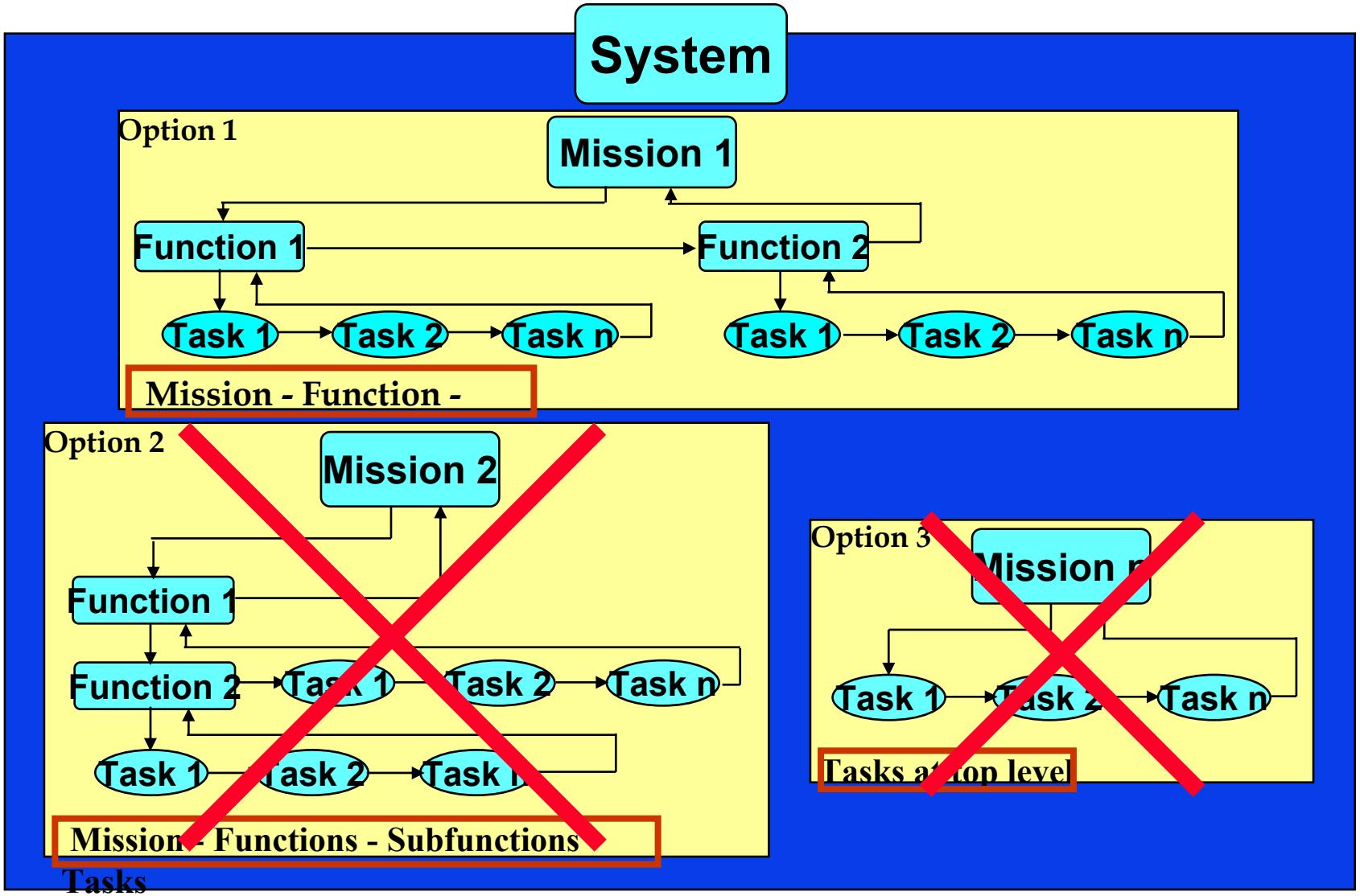
Practical Exercise

Advanced Modeling

Advanced Modeling vs. Advanced workload

- Advanced modeling capabilities allow you greater flexibility in controlling the sequence of events in your model
  - Effects tab
- Advanced workload is another model for predicting workload based on multiple resource theory

Task Network Hierarchy Options in Advanced

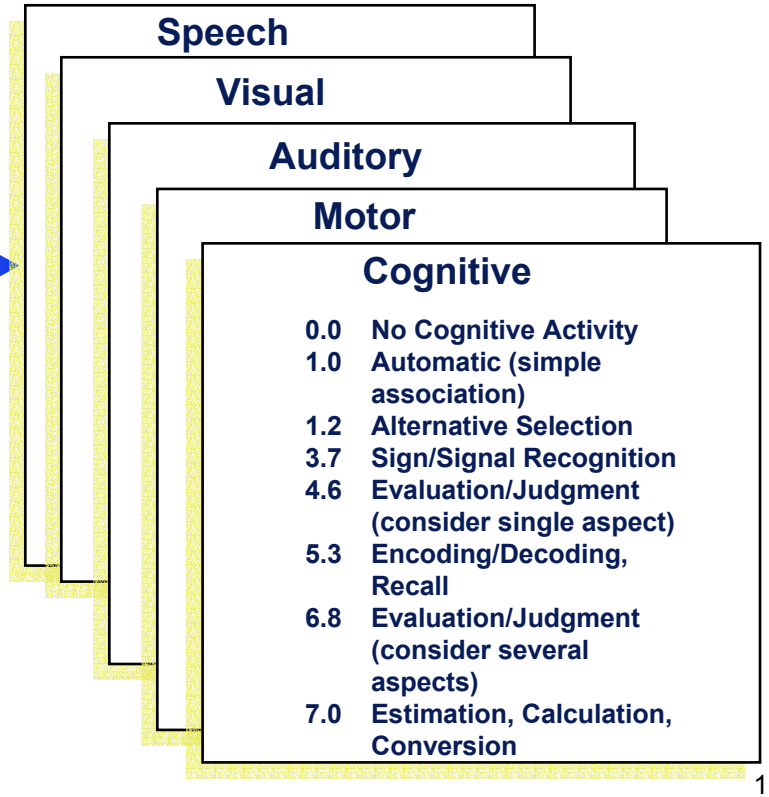


Multiple Resources Theory of Mental Workload

Mission Tasks → **Which Brain Resources Involved?** → **Degree of Resource Use?**

1. monitor alarms
2. decide response action
3. pull trigger
.
.
.
n. task n

- Visual
- Cognitive
- Auditory
- Motor
- Speech



Aggregate Workload

ADVANCED WORKLOAD CALCULATION:

$$W_T = W_{STD} + (W_{WCC} + W_{BCC})$$

Where:

W_T = Instantaneous Workload at Time T

W_{STD} = Workload attributable to the demands of all operator's tasks at time T (Single Task Demands)

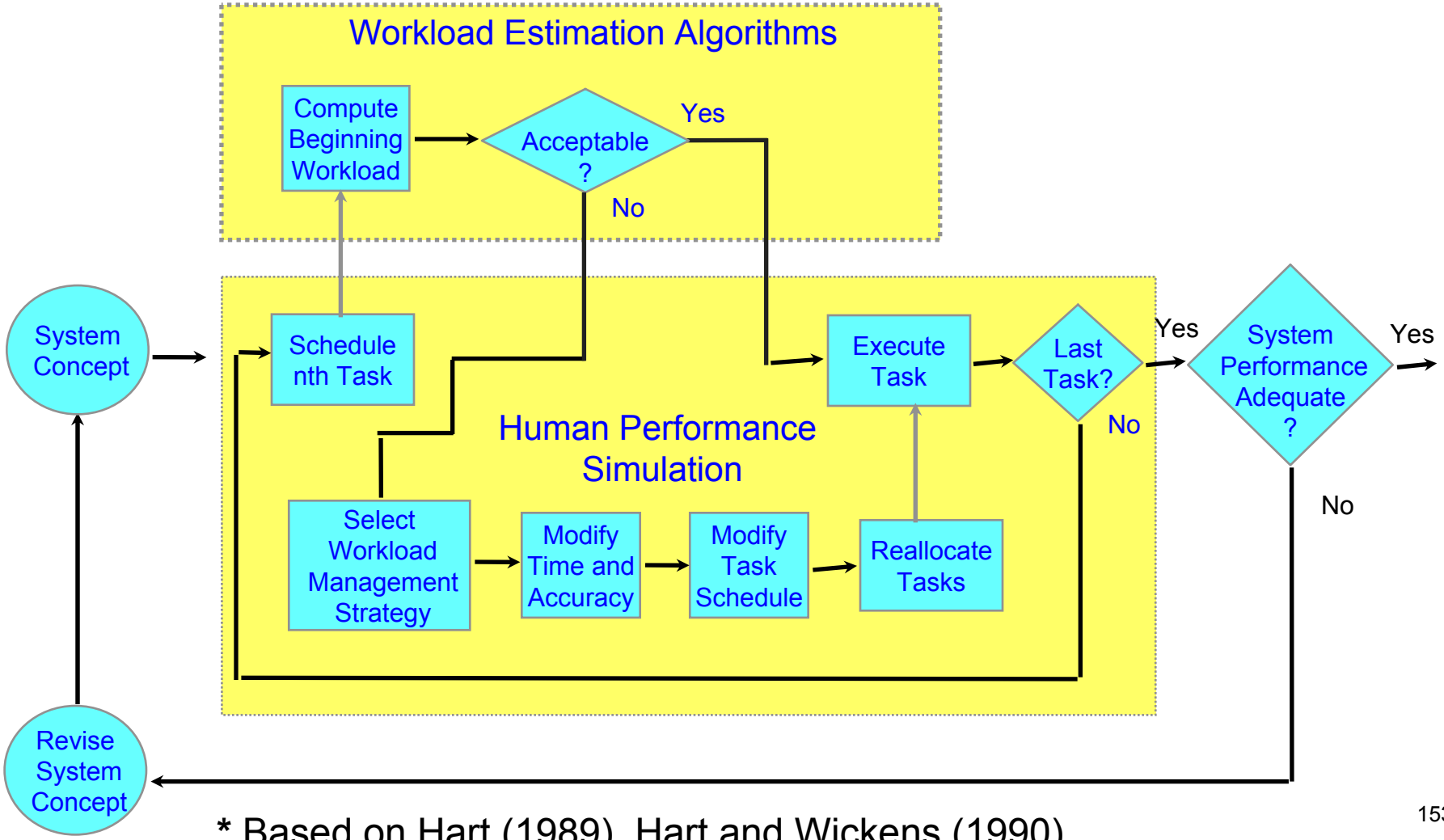
W_{WCC} = Workload attributable to Within-Channel Conflicts (Within and between tasks)

W_{BCC} = Workload attributable to Between-Channel Conflicts (Between tasks only; within tasks may see improved performance "S-C-R")

*Adapted from W/Index North & Riley, 1988

Advanced Workload Coping Behaviors

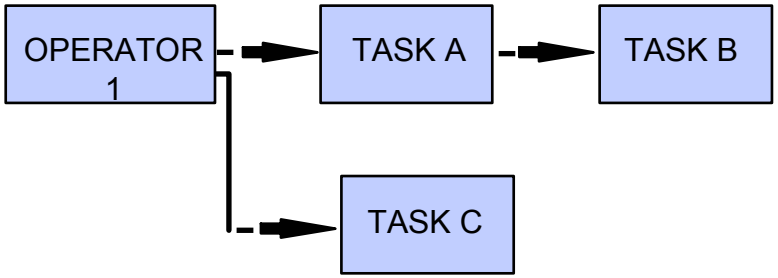
Interaction of Human Performance and Workload Estimation Algorithms



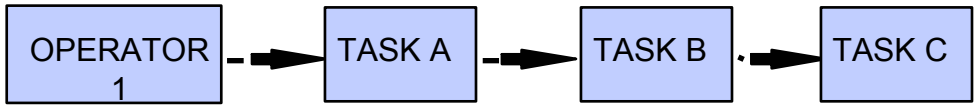
* Based on Hart (1989), Hart and Wickens (1990)

Workload Management Strategies Illustration

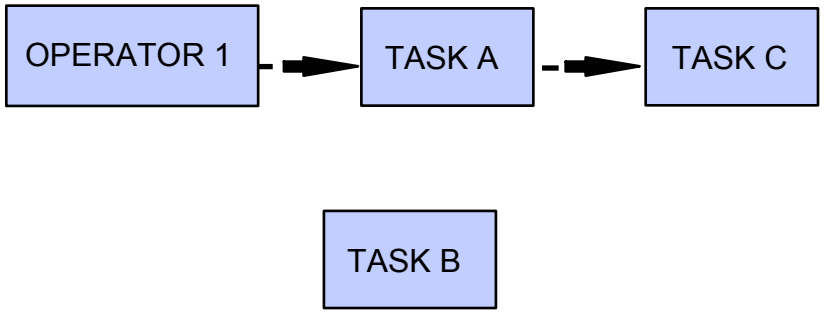
Strategy - Perform the Tasks Concurrently Despite Overload



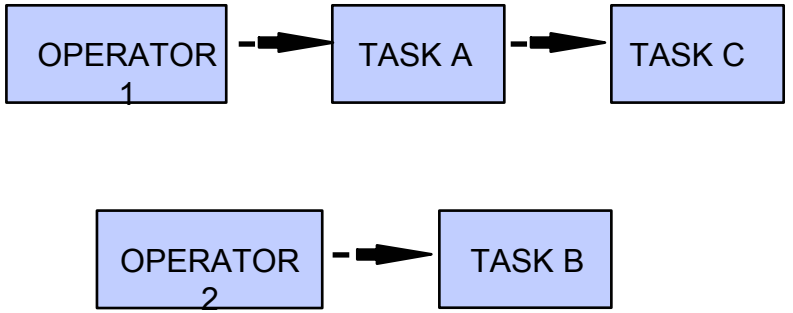
Strategy - Perform the Tasks in Series Rather than in Parallel



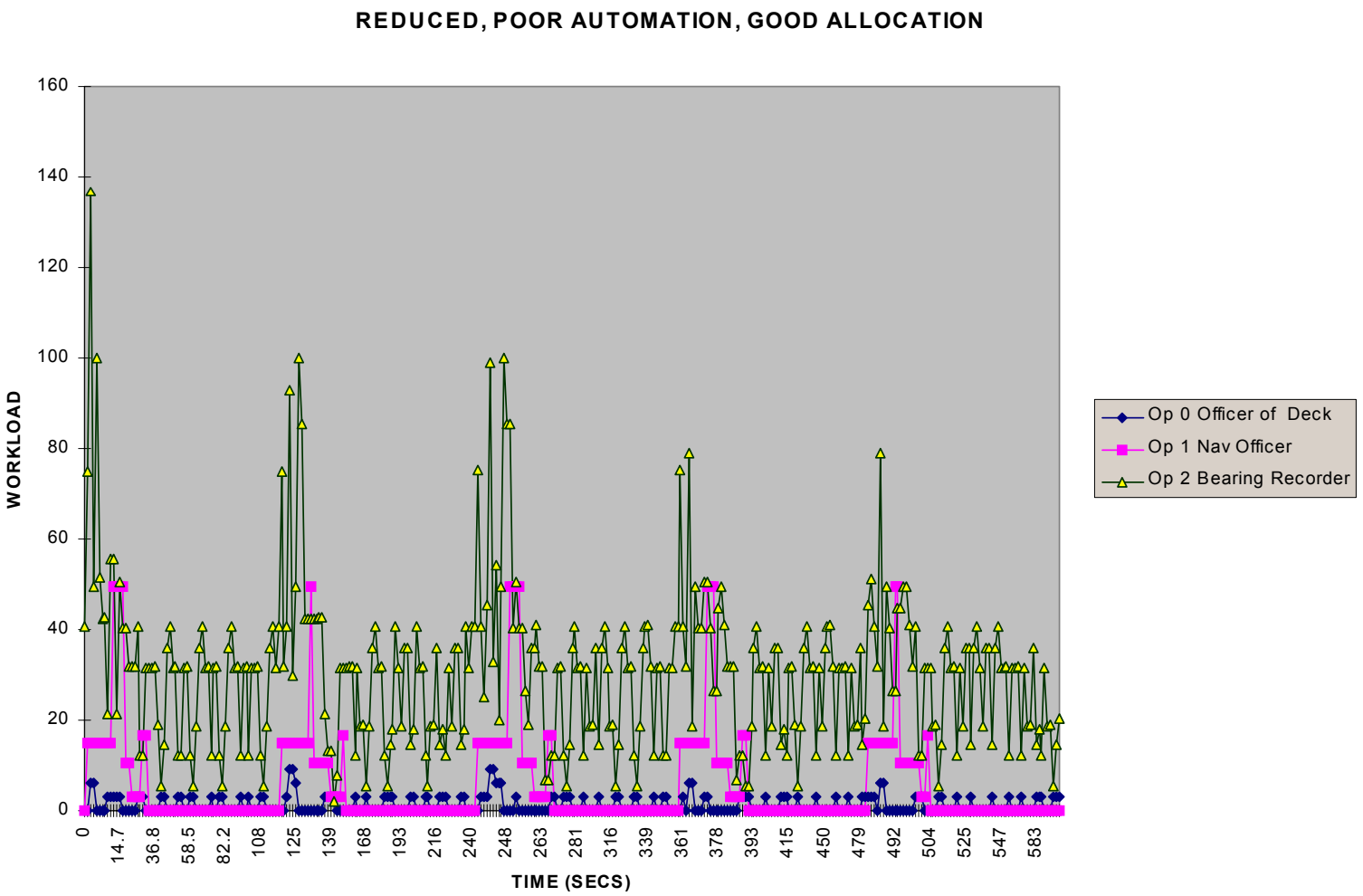
Strategy - Drop one of the Tasks



Strategy - Reallocate Tasks to Another Qualified Operator



Sample WinCrew Output



Advanced Workload Method

- Describes effort needed to perform task
- To help examine impact of workload during mission
- Results are combined across channels into one score
- Results consider inter- & intra-channel conflict
- Does dynamically impact performance

Time, Accuracy, Crew Allocation, Sequence

Unique Outputs of Advanced Workload

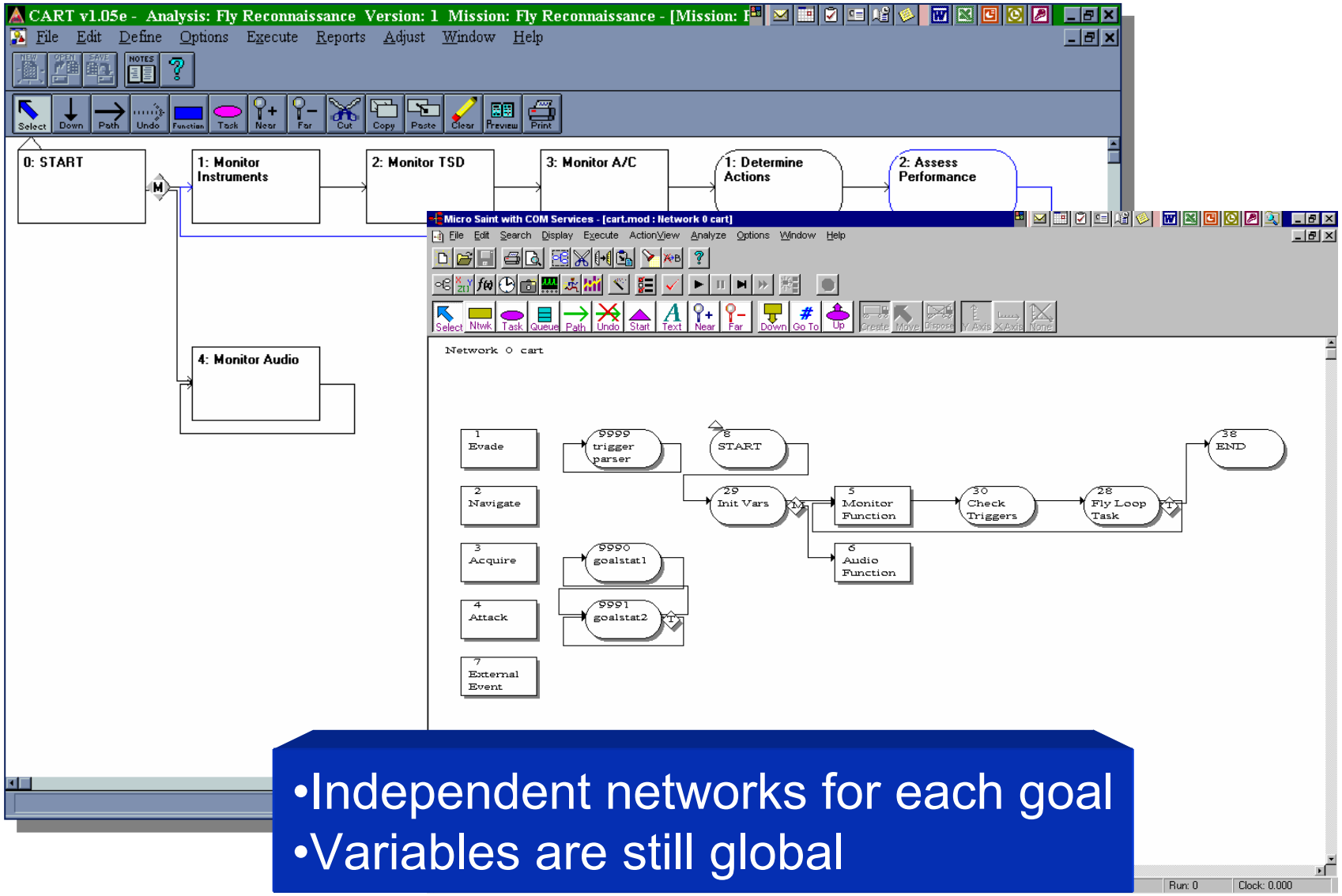
- Critical Path
- Operator Activity
- Operator Workload
- Overload
- Channel Conflict
- Task Timeline
- CrewStation Workload
- User Snapshot

Goal Oriented Modeling

Goal Oriented Modeling

- Goal orientation
  - Option from VACP
  - Beginning & Ending Effects
  - Variable Catalog
  - Macros (User-Defined Functions)
  - Snapshots
- COM capabilities
  - Including HLA Middleware
- Access to tag

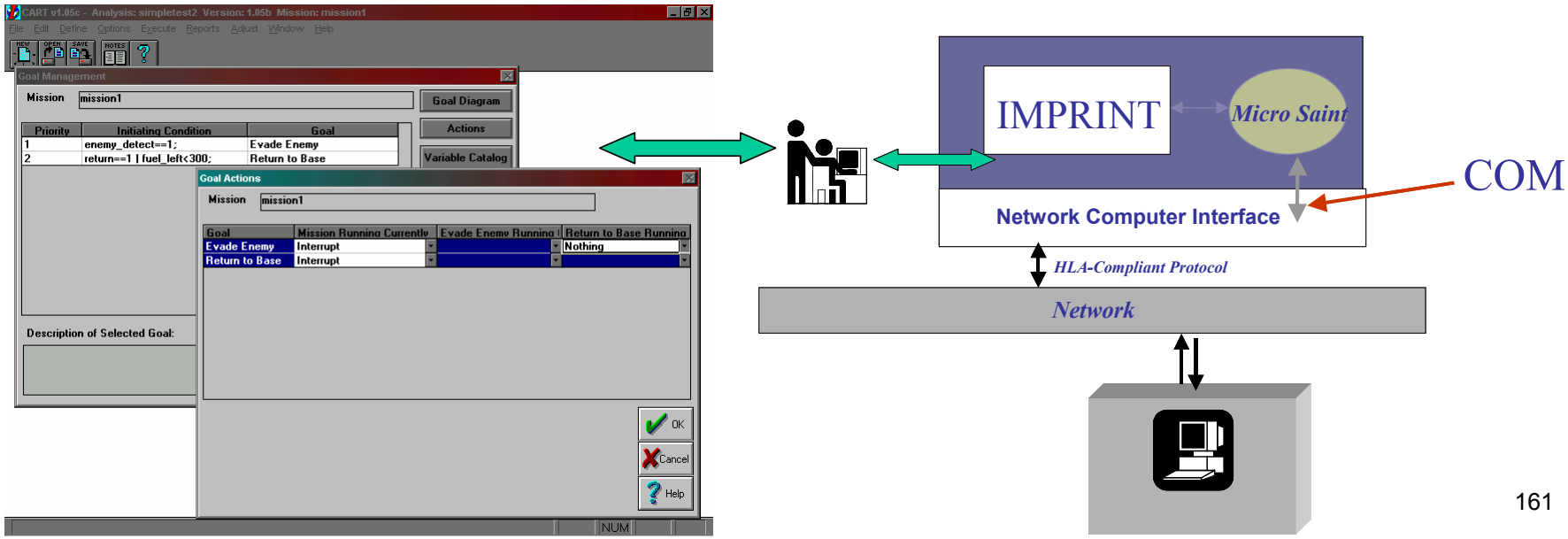
Task Network Model Development

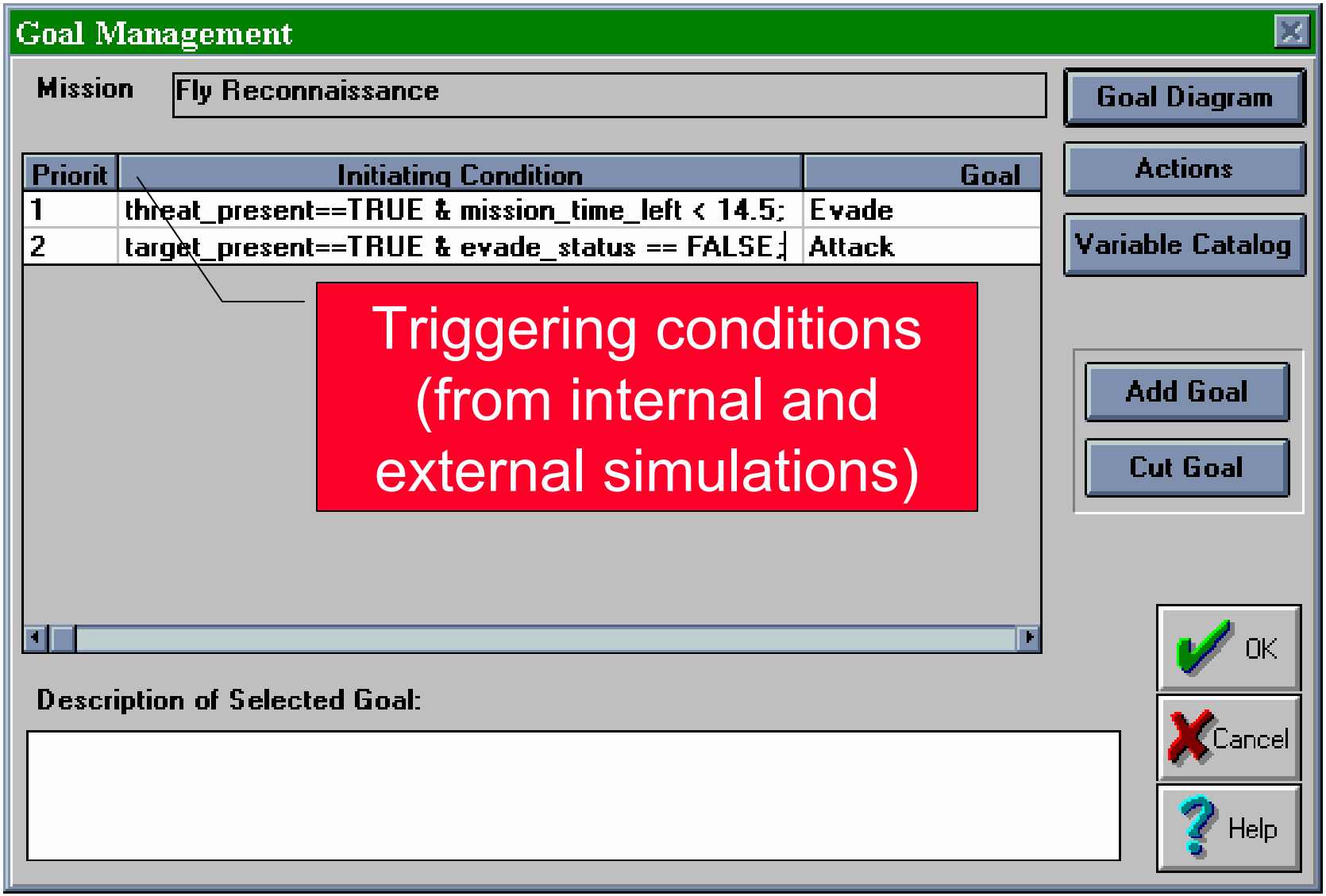


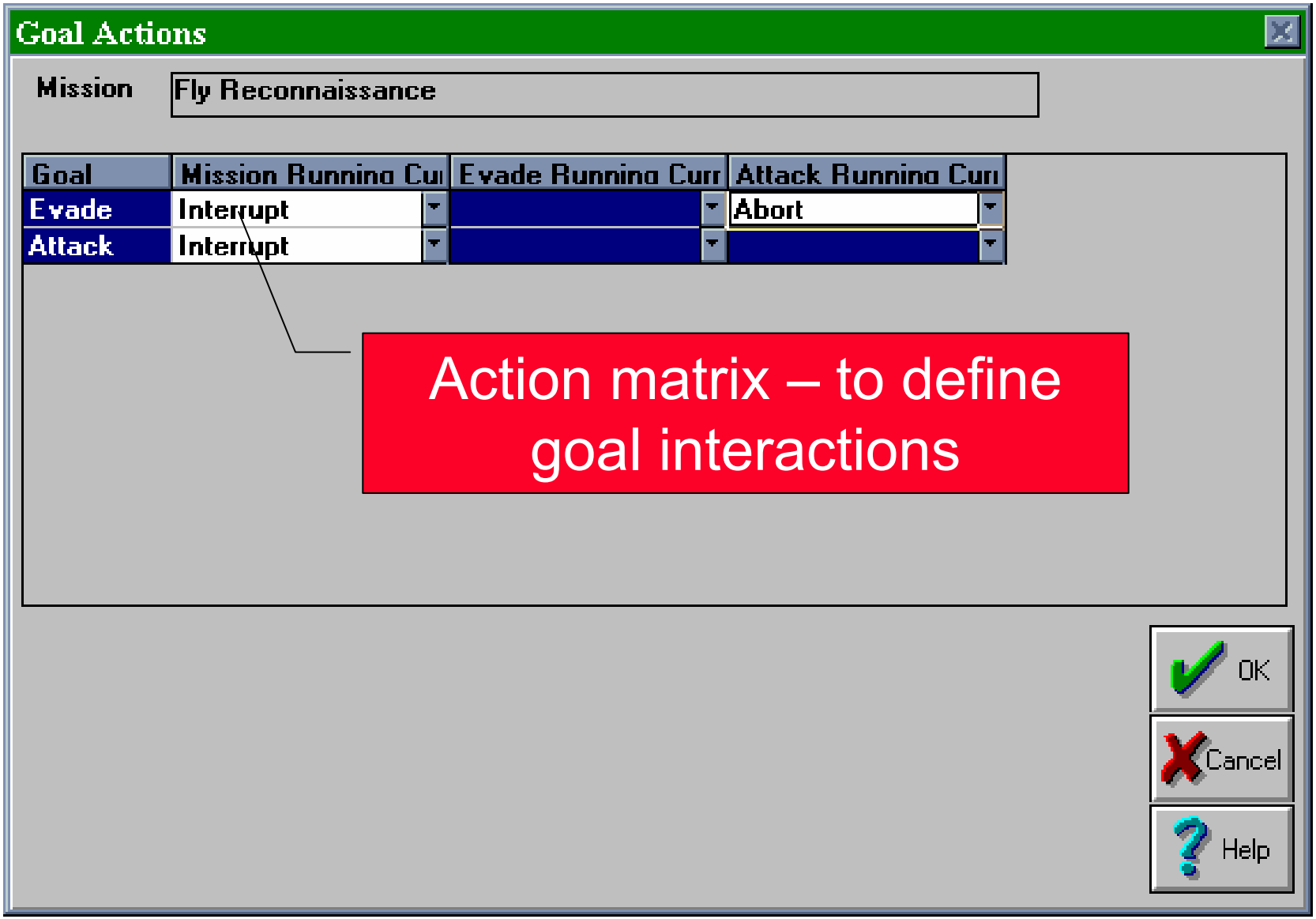
- Independent networks for each goal
- Variables are still global

Goal Functions

- Trigger identification
- Trigger communication
- Task interruption
- Task restart vs. task resume




Goal Management
Mission
Fly Reconnaissance
Goal Diagram
Actions
Variable Catalog
Priorit
Initiating Condition
Goal
1
threat_present==TRUE & mission_time_left < 14.5;
Evade
2
target_present==TRUE & evade_status == FALSE;
Attack
Triggering conditions (from internal and external simulations)
Add Goal
Cut Goal
OK
Cancel
Help
Description of Selected Goal:


Goal Actions
Mission
Fly Reconnaissance
Goal
Mission Running Cur
Evade Running Curr
Attack Running Curr
Evade
Interrupt
Abort
Attack
Interrupt
Action matrix – to define goal interactions
OK
Cancel
Help

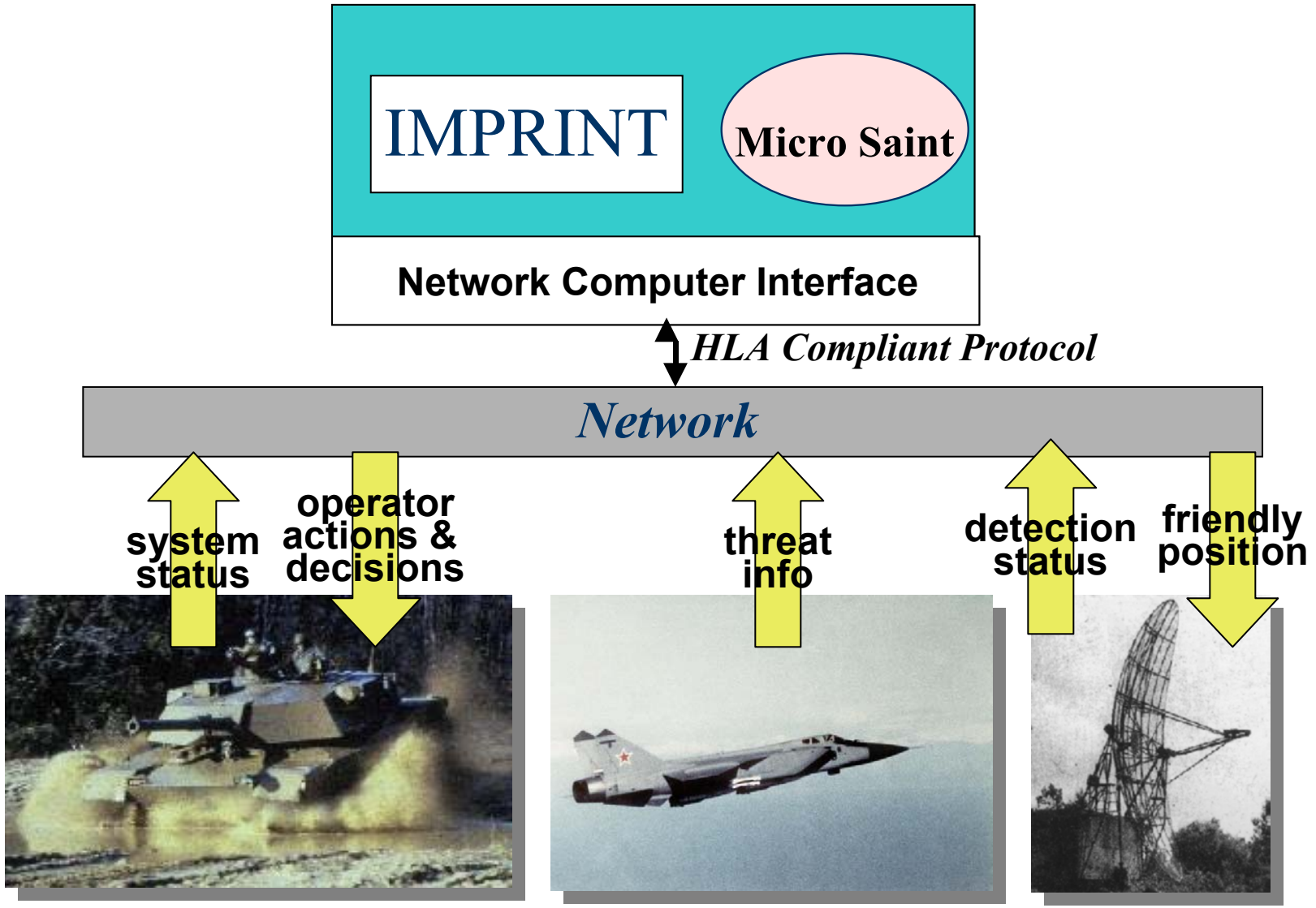
Goal Rules

- **When a trigger comes true:**
  - Look UP the matrix to see if a higher priority goal would suspend or halt it. If so, don't start it, but keep trying.

    If not:
  - Look DOWN the matrix and implement the actions for all lower priority goals

- **When a goal ends normally, gets halted or gets suspended:**
  - Resume anything it suspended UNLESS a higher priority goal would halt it. If so, halt it. If a higher priority goal would suspend it, then suspend it.

System Architecture



News of Note

- AF Validation Success Story
  - Wright Pat SIMAF Virtual Strike Warfare Environment
  - Time critical targeting (SCUD Hunt) mission
  - HPM vs. Eight pilots (F16 and A10)
  - Overall kills of ground targets in the time critical scenario was virtually the same for both the model and pilots (100% and 98%, respectively)
  - HPM accounted for 61 percent of the behavior of the pilots in the simulation environment
  - New tactic discovered: Coordinated use of synthetic aperture radar (SAR) and targeting infrared (TIR) imaging system

Why would you use Goal-Oriented?

1. **When you want VACP workload and the ability to use effect modeling**

2. **When you want to represent human behavior using goals**

3. **When you need to talk to other simulations**

You can switch from VACP or Advanced to Goal oriented with caveats!

Wrap-Up Discussion

Lessons Learned

- Save ! Save! Save!
- Never too many DUMMIES…
- Naming Conventions

Getting the Software

Who

- Any government agency
- Private industry with government contract
- Foreign government (case-by-case)

How

- Send request via e-mail or letter
- If private industry include government contract number and organization

Non-Distribution Form

- Keep track of users
- Reminder not to distribute

Software Distribution

Technical Support

ARL-HRED

- Ms. Celine Richer (cricher@arl. army. mil)
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  (410) 278-8830
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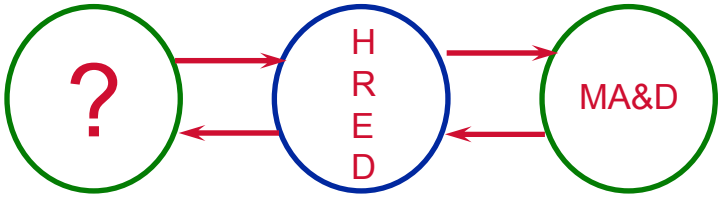
  (410) 278-5877



Maintain Database

- User comments
- “Bugs”
- “Fixes”

Using the List Server

List of current IMPRINT users & interested parties

Send suggestions, comments, general information or questions regarding IMPRINT to

imprint@arl.army.mil

References

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- Allender, L., Kelley, T., Archer, S., and Adkins, R., (1997). IMPRINT The Transition and Further Development of a Soldier-System Analysis Tool. MANPRINT Quarterly,Office of the Deputy Chief of Staff of Personnel, Vol. V, No. 1.

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- Mitchell, D., Samms, C., Henthorn, T., Wojciechowski, J. (2003). Trade Study: A Two-Versus Three-Soldier Crew for the Mounted Combat System (MCS) and Other Future Combat System Platforms. (ARL-TR-3026) Aberdeen Proving Ground, MD: Army Research Laboratory.